Stanford SILICONVALLEYNEWJAPAN PROJECT

Stanford | Shorenstein APARC | Japan Program

SVNJ Working Paper 2015-6

A Strategic Overview of the Silicon Valley Ecosystem: Towards Effectively "Harnessing" Silicon Valley

Kenji Kushida, Stanford University

A Strategic Overview of the Silicon Valley Ecosystem: Toward Effectively "Harnessing" Silicon Valley

March 15, 2015

Kenji E. Kushida, Ph.D.[*]
Stanford University

We sincerely thank supporters of the Stanford SV-NJ project for making this report possible. As of March 2015, these include the following. Platinum level: NIRA, WiL, Komatsu; Silver level: ANA, Bank of Tokyo-Mitsubishi UFJ, NEDO, Omron, Rakuten, and Startia.

Executive Summary

There has been a prolonged discussion in Japan, followed by various policy actions, to create an environment conducive to startups in order to accelerate innovation. While much of the policy focus until now has been on how to import or duplicate various aspects of Silicon Valley, it is now time to add another stream of discussion to the conversation: how Japanese policymakers and corporations can best make use of Silicon Valley. In order to add this new stream of conversation, it is critical to first gain a shared in-depth understanding of Silicon Valley itself as an economic ecosystem—not simply how it functions today, but how and why it developed into its current form. Only by understanding the trajectory of development over time can we project how certain changes are likely to happen in the future, and what lessons should be drawn on how to harness the ecosystem for Japan.

This report provides an overview of the Silicon Valley ecosystem. It draws upon existing scholarship and original insights to derive a picture that is only partially well-known in Japan. Characteristics such as the critical role of large firms for the startup firm ecosystem, the role of Japanese firms in creating the US firms' "open innovation" paradigm, and the severe lack of local government coordination in providing public transportation creating opportunities for disruptive startups such as Uber, are all aspects of Silicon Valley that are not well-known in Japan. This report also delves into industry-university ties in the crucial research universities of Stanford and University of California Berkeley, highlighting the multifaceted and bidirectional interactions between universities and industry that are often not captured by the common "technology licensing office"-centered view. In the final section, this report briefly reviews a representative set of challenges often cited by large Japanese firms attempting to make use of the Silicon Valley ecosystem, concluding by suggesting areas for further research.

[*] Research Associate, Stanford University; Project Leader Stanford Silicon Valley – New Japan Project, International Research Fellow, Canon Institute for Global Studies.

Table of Contents

1. Introduction

Silicon Valley has produced successive waves of disruptive technologies and innovations that have profoundly affected the world since the invention of the transistor. Firms that began as startups revolutionized the world of computing, unlocking a vast array of possibilities for how computing power can be applied to all areas of civilization and ushering in the digital information age we currently live in. Firms including Hewlett Packard, Intel (microchips), Western Digital (Hard disks), Sun Microsystems (Servers and Workstations), 3Com (data networking) Cisco Systems (Internet networking equipment), Oracle (databases), and Apple were all originally startups that shifted the very basis of computing technology. Biotech innovations were driven by firms such as Genentech, and more recently, the region has spawned Internet and services giants such as Yahoo!, Google, eBay, PayPal, Facebook, Twitter, Salesforce, and Evernote. New firms continue to disrupt a broad variety of industries, such as Tesla (automobiles), GoPro (video recording), Cargotec (port management systems), AirBnB (hotels and accommodations), Uber (taxis and transportation), Flipboard (media) and there are strong competitors in area such as solar (Sun Power), medical devices, and other areas.

As Japan looks to transition to the next stage of economic development, which will necessarily rely on innovation and productivity gains in pursuit of high value added activities, lessons from Silicon Valley are likely to become more critical than ever.

Countries around the world have attempted to duplicate Silicon Valley's "ecosystem" of successful innovation. However, almost all have failed.[1] The time has come to *not simply try to copy* aspects of Silicon Valley, *but also make use of the Silicon Valley ecosystem itself* by becoming active participants. Silicon Valley continues to produce disruptive innovations, and many will severely disrupt existing business models in Japan in a variety of industries, ranging from media to automobiles, to other areas we do not expect yet. Taking the metaphor of Commodore Perry's Black Ships that sailed into Edo Bay in 1840—the next "black ships" that will disrupt industry are likely to come from Silicon Valley, so *instead of waiting for the black ships to arrive, Japan should go to where they are being built*—to Silicon Valley.

Large Japanese firms have a long history of having offices and some form of presence in Silicon Valley. However, overall, they have faced more challenges than successes in making use of Silicon Valley, and a core hurdle has been becoming an integral part of the innovation networks.

This report is a first step in finding solutions for *why* Japanese firms have had difficulty making use of Silicon Valley, with *implications for what they can do*. This report goes beyond simply looking at how Japanese firms have behaved in Silicon Valley. Nor is it simply a comparison between Silicon Valley and Japan. Rather, it is focused on an in-depth understanding of how Silicon Valley operates and how it developed, with aggregated and generalized

[1] Deitch, K. and S. Deitch (2002). The boulevard of broken dreams. New York, Pantheon Books.

experiences of Japanese firms in Silicon Valley in order to search for lessons for Japanese firms, as well as the government.

There has recently been a surge of Japanese startups and young firms entering Silicon Valley. Startups such as SmartNews are becoming well known even outside of the Japanese community. Firms that are relatively new, such as Rakuten, DeNA, and Softbank are also actively increasing their presence, expanding rapidly through M&A. Large incumbent firms such as NTT have recently increased their focus on Silicon Valley, Canon runs its global non-printer and camera division out of Silicon Valley, and aggressively successful firms such as Omron and Komatsu are entering (or re-entering) with renewed focus and purpose. Everybody is eager to learn, and many are looking for information. This report provides a solid basis upon which to build expectations and strategies. Much of the useful information about Silicon Valley has been locked inside academic publications that have not been simplified and digested for mass consumption by busy people, so a core aim of this report is to fill that gap.

This report first provides a detailed overview of Silicon Valley, providing a unique vantage by highlighting the role of Japanese firms in the development of Silicon Valley's ecosystem. It looks at the financial systems, diversity of employment, roles of government, and university-industry ties. The final section provides an overview of key challenges facing Japanese firms, which constitute the basis of a further research agenda.

2. The Silicon Valley Ecosystem: Overview

Silicon Valley has a variety of business organizations and institutions that create a business environment that has proved to be highly conducive to the successful creation of startup firms, disruptive business models, and leadership in a variety of high-tech areas. The various components and characteristics of Silicon Valley that fit together and exhibit complementarities and "make the system work" are best referred to as the Silicon Valley "ecosystem."[2]

What are the key components of Silicon Valley, how do they work, and how do they fit together? In this section, we introduce the Silicon Valley ecosystem, drawing upon existing research on Silicon Valley.

Below is a broad overview of various characteristics of Silicon Valley most commonly cited as being the distinctive contributors to its success. These factors will be examined in further detail as part of the four components below, and it is not intended as an exhaustive list. Rather it is a set of characteristics often noted about Silicon Valley that have empirical underpinnings.

Figure 1. Key Characteristics of the Silicon Valley Ecosystem

Characteristic
• Dual ecosystem of large firms and startups
• High financial returns for successful entrepreneurs and startups' early employees
• Global top-level human resources for all stages of startups
• Business infrastructure (law firms, accounting firms, mentors, etc.)
• Venture capital – most competitive market
• Globally top class universities (Stanford, UC Berkeley, UCSF)
• Human resource clusters anchored around top universities
• Extensive government role in shaping technological trajectories and basic science
• Highly competitive industries, balance between "open innovation" and secret protection
• Balance of "open innovation" and intellectual property protection
• "Technology Pump" of top human resources from all over the world
• High labor mobility at all levels of management and talent
• Culture of accepting failures (effective evaluation and monitoring)

Source: Miller et al. (2000), "Innovations" (2015)

First, Silicon Valley has a business ecosystem in which *both large firms and startups exist symbiotically*. Silicon Valley is sometimes seen as mainly a mecca for startups, but in many ways it is the coexistence of large firms, which provide markets for startups' offerings, a source

[2] It has also been referred to as a "Habitat." We prefer "ecosystem," since "business ecosystem" is now a more common phrase in business writing. Lee, C.-M., W. F. Miller, M. G. Hancock and H. S. Rowen, Eds. (2000). <u>The Silicon Valley edge : a habitat for innovation and entrepreneurship</u>. Stanford, Stanford University Press.

of human capital, and often expertise, along with startups that make the ecosystem viable. Some startups eventually grow to become large firms, spawning new firms as employees leave to startup, fueling a virtuous cycle.

Successful entrepreneurs and early employees can expect *high financial returns*. Pay schemes such as stock options were initially devised as mechanisms to lure employees away from stable large firm jobs, and M&A and IPO activity enable high returns.

Silicon Valley enjoys an extremely *deep human resources pool* in which people from all over the world come to compete. Silicon Valley has people who have deep expertise in every stage of a startup, from initial startup to rapid growth, to increasing maturity. Taking a vision to make a company is the first step—expertise to manage a high growth startup to a mid-sized firm, to a large firm usually requires a different set of expertise, and Silicon Valley's long history of growing companies has led to people who have long careers at particular stages of company growth.

The *business infrastructure* of Silicon Valley, such as law firms, accounting firms, mentor networks, and other aspects provides value to entrepreneurs and startups beyond the direct financing or services rendered. Law firms that specialize in serving startups, for instance, are often paid only if the startup is successful, so they do their own screening when taking on new firms as clients. They can also act as business advisors and deal-makers, having dealt with a very large number of successful startups.

Silicon Valley has the most *competitive venture capital market* in the world. Not only does the amount matter, but the extra value that venture capitalists provide such as interpersonal networks for startups' initial employees and staff, and introductions to potential customers and buyers of the firm are all important value-added functions they provide beyond financing. Their initial screening of potential startups, and startups as they grow through various stages, provides a critical monitoring mechanism, often with hands-on assistance in managing the company.

Silicon Valley itself has *extremely competitive industries*. Competition among startups is intense and cutthroat. Moreover, while they benefit immensely from large firms' "open innovation" practices that allow them to sell their offerings and often the company itself to large firms, it is also balanced by intense secrecy. Apple and Google, for example, are famous for keeping their employees from revealing secrets, and startups are often extremely careful of letting their business models or technologies become known to firms that could become major competitors.

Globally top-class research universities, Stanford University and University of California (UC Berkeley and UC San Francisco Medical Center) anchor Silicon Valley in scientific and applied research, forming communities of expertise and interpersonal networks that continue to drive innovations in the region. These research universities were instrumental in developing Silicon Valley in the first place, and they derived benefit from being in or near Silicon Valley to remain globally leading universities. The universities provide *focal points of human resource clusters.*

Top talent from all over the world have come to Silicon Valley through universities, firms, and favorable temporary immigration visas. Historically younger than East Coast counterparts, Stanford and UC Berkeley populated their faculty with top immigrants, who came in various waves throughout the past century—Europeans, South Asians, and various Asian.

While many entrepreneurs tend to downplay the role of *government*, the government was not only critical to establishing Silicon Valley, but it continues to fund much of the basic research in the area. Some have referred to it as a "de facto" industrial policy, as we will see later.

Labor mobility in Silicon Valley is higher than in other areas of the country, and is particularly high in the information technology industries. Large firms struggle to retain high quality employees, while startups absorb a great deal of talent, but end up becoming large firms through growing on their own or getting acquired, then facing the same dilemma as large firms of keeping employees. Consequently, wages have risen considerably. Moreover, even top management talent, such as top executives of firms such as Google, can move to other firms such as Facebook or become founders of firms such as Twitter, revealing how talent can move around at all levels within companies.

Finally, Silicon Valley is widely known to have a *culture of accepting* failure as a positive experience if the failure led to important lessons. Underlying this culture is an *effective set of mechanisms for evaluating and monitoring* entrepreneurs and startups, allowing "successful failures" to become the stepping stone for subsequent successes. Many noteworthy startups, more recently including Dropbox and others, were not the first, but rather the second or third attempt by the entrepreneurs before becoming successful.

Many of these characteristics will be examined in further detail below.

3. Where is Silicon Valley? The Geography of the "Greater Silicon Valley Ecosystem"

One of the first questions for Japanese firms looking to establish a presence in Silicon Valley is: where exactly is Silicon Valley, and what is the best strategic location?

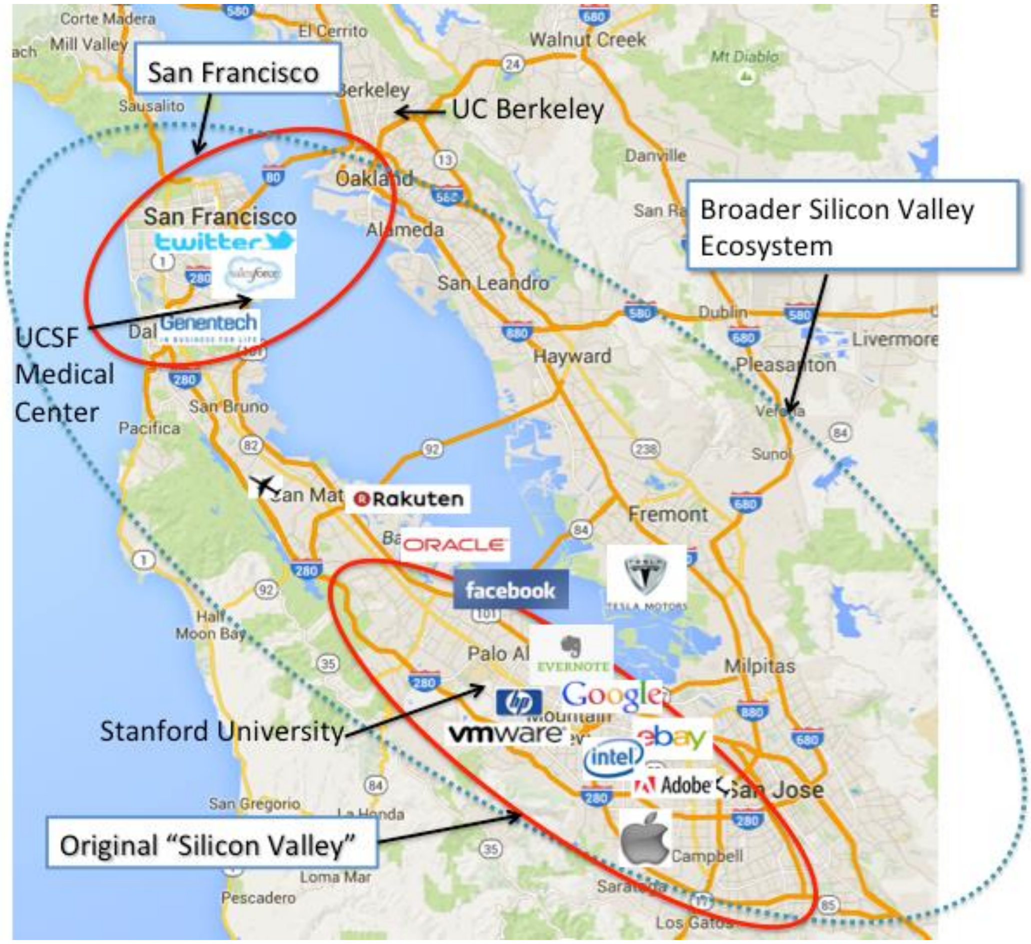
Silicon Valley is one of the most important locations in the world that does not show up on a map. The question of exactly which areas to include in the label "Silicon Valley" therefore matter a great deal in any data collected, and in understanding how the economic ecosystem works. It is also critical in the sense that there is no "Silicon Valley government" – the region is instead a collection of counties. It has generally referred to the Santa Clara valley area, which includes Santa Clara County, stretching from Menlo Park to San Jose.

However, as an economic region, Silicon Valley has grown to encompass a far larger portion of the San Francisco Bay Area. Firms such as Genentech and the biotech cluster it spawned are located in South San Francisco, and startups such as Salesforce.com and Twitter are located in San Francisco itself. Google and other firms run buses from San Francisco to Google headquarters in Mountain View, and the mobility of employees means that a robust startup ecosystem in San Francisco shares many of the same financial, human resource, and idea flows as what was traditionally considered Silicon Valley. Moreover, the University of California Berkeley has been a key contributor to the Silicon Valley ecosystem, but it is located East of San Francisco, across the Bay Bridge. As housing and land prices have skyrocketed in Santa Clara County and San Francisco, many of the middle-tier employees of Silicon Valley cannot afford to live comfortably in the Peninsula, and back office operations for startups that successfully expanded were no longer cost effective to retain in the Peninsula. The Silicon Valley ecosystem therefore expanded in the East Bay, to Alameda County and beyond, with large numbers of workers commuting for firms such as Apple and eBay from large and more affordable homes in the East Bay. Large back offices began expanding into office parks in Fremont and other areas, as well as some factories including that of Tesla Motors.

As an economic ecosystem, therefore, we need to consider a broader segment of the Bay Area as part of the Silicon Valley ecosystem to capture the flow of people, finance, and ideas. The lack of an integrated or well-funded public transportation system are challenges for this fragmented conglomeration of counties. While this hinders growth of the region, and certainly places a heavy burden on workers, it also facilitates conditions under which new startups solving local problems can scale globally; Uber, for example, solved a very real problem for people in the Bay Area for whom convenient transportation was a challenge.[3]

[3] Given that Uber's revenue from the Bay Area far exceeds that of the entire taxi industry before Uber arrived, there is strong evidence that people who would otherwise not have taken taxis are now using Uber, so it is not simply a substitution for taxis.

Figure 2. Greater Silicon Valley



4. Startups in the Silicon Valley Ecosystem: How They Relate to Large Firms and Other Actors

In order to understand the strategic options available to large Japanese firms in Silicon Valley, we must first understand the role of large established firms in the Silicon Valley ecosystem. As noted earlier, large firms have a symbiotic relationship with startup firms. We therefore examine the role of large firms in Silicon Valley with respect to the logic of how startups firms view other actors in the ecosystem.

A successful environment for startup firms requires startups to access markets for their innovative products and services. The primary question is therefore: who are the buyers of startups' products and services? The secondary question, in order to better understand why the system functions as it does, is: why did these buyers become critical purchasers of startups' products, services, and startup firms themselves?

The primary buyers of Silicon Valley startups' products and services, other than consumers (B to C), are **large firms**. This includes traditional large firms that have existed for a long time, such as IBM, Lockheed, and HP, as well as large firms that became large relatively recently, ranging from Apple and Oracle to Google and Facebook.

Large firms provide market access for start-up companies in two main ways. First, they may serve in traditional customer roles. This is especially important when large companies become the first customers or reference customers to start-ups. Second, large companies may acquire start-up companies through M&A activity. In this case, the large company can provide its resources to make the idea of the acquired start-up company achieve even greater and/or more rapid market success than the start-up could attain otherwise.

The role of **government** as a major lead buyer for Silicon Valley startups' products and services is often understated in analyses of Silicon Valley—particularly among many participants themselves in Silicon Valley. The government, which includes the military and aerospace, played a critical role in the historical development of Silicon Valley, and continues to exert a significant presence in shaping technological trajectories.

4.1. Large firms as customers

Large firms have traditionally acted as lead buyers of startups' products and services. This has enabled startups to move well beyond consumer-oriented products and services (B to C) and become critical game-changers in business-oriented (B to B) economic activities. There are three distinct patterns of dynamics worth highlighting.

The first is that *established large firms*, such as those listed on the New York Stock Exchange (NYSE), which can be headquartered anywhere, are willing to purchase startup firms' products and services. Firms ranging from Citibank to Chevron, which go well beyond the IT industry, are willing to buy software and services from startups.

A good recent example of beneficiaries of this dynamic is Salesforce.com, founded in 1999 by a former Oracle executive. Salesforce.com originally provided Customer Relations Management (CRM), disrupting the packaged software CRM industry by offering CRM as a service that was "pay-as-you-go." Salesforce.com's services grew to a platform that allowed third-parties to offer specialized software services, further enhancing the core offerings of Salesforce.com. The company's success in getting large firms as early customers enabled it to grow at a meteoric rate, leading to its 2004 IPO on the NYSE. Without large companies as customers, it would not have been possible to attain this growth level. For large firms, switching from existing vendors for something as core as CRM was not a trivial decision, but they were willing to switch to the startup's services once they understood its potential and functionality, especially as they saw others adopting it.

A broader point is that the US-centered information technology (IT) revolution owes much of its rapid development to lead users, which are large corporations, who aggressively install IT systems.[4] The historical pattern has been that they often install computer systems to solve one type of problem—such as airlines installing reservation management systems—only to discover that they can use that information to completely reorganize the business. In the airline case, this meant discovering that with reservations information, they could implement a new system of supply and demand management to effectively route their airline routes to radically increase operating efficiency. This role of *large corporations as lead users of IT* has contributed to their being receptive to adopting products and services from startups. A key reason that innovation large corporations become lead users is that they are subject to high levels of competition.

Many of the large established firms have established branch offices in Silicon Valley to gain a foothold in the area and access information early. As a historical study notes, large East Coast firms have a long history of attempting to take advantage of Silicon Valley, with limited success.[5]

The second dynamic of large-firm purchasing of startups' products and services is by *established Silicon Valley IT* firms, which often started as startups themselves, becoming major customers of startups. Apple, for example, originally a Silicon Valley startup, famously procured its iTunes software from outside the company, later integrating it into its iPod music player and online music store that disrupted the music industry. Hewlett Packard, which was founded by Stanford graduates with the support of key faculty, is also headquartered next to Stanford, has actively purchased startups.

---

[4] Cohen, S., J. B. DeLong and J. Zysman (2000). Tools for Thought: What is New and Important about the "E-conomy". Berkeley, CA, Berkeley Roundtable on the International Economy, University of California at Berkeley.
[5] Kenney, M. (2000). Understanding Silicon Valley : the anatomy of an entrepreneurial region. Stanford, Calif., Stanford University Press.

Silicon Valley actually traces its historical roots to developing and manufacturing advanced electronics components, growing from large firm and government buyers. From the early 20th century, when large East Coast firms such as RCA dominated consumer products and held a wide range of intellectual property, San Francisco Bay Area firms began specializing in high-end electronics components. The initial area of their expertise included long range radio and communications technologies, since the Bay Area faces the Pacific. These firms focused on niche, specialized areas—one might consider the core business model for almost a century as depending on large buyers.[6]

4.2. Government as Lead Buyer of Silicon Valley Technologies

Government as a lead buyer has been a crucial driver of startup growth in Silicon Valley since its early days.[7] Many of the early radio technologies were sold to the US Navy, which was rapidly expanding into the Pacific as the US projected its power towards Asia. In the postwar period, the Cold War with the USSR created massive pressure for the US government to pour resources into science and technology development, especially after the USSR was first to successfully launch an orbiting satellite, the Sputnik.

Aeronautics and aerospace were areas of concentration in the Bay Area. Lockheed Missiles and Space (which later became Lockheed-Martin) was the largest employer in the area for much of the postwar period (28,000 at its peak), with a majority of its sales going to government. Semiconductors and other specialized technologies pioneered by startups also had government as the key lead buyer. As of 2000, Silicon Valley was one of the leading recipients of defense contracts, receiving about four times the national average and twice per worker what Los Angeles—another focus point of military-industrial collaboration, receives.[8]

The military played a critical historical role in growing startup companies from Silicon Valley into large companies during the Cold War. Varian Associates[9], Watkins-Johnson[10], and

---

[6] Sturgeon, T. J. (2000). How Silicon Valley came to be. Understanding Silicon Valley: Anatomy of an Entrepreneurial Region. M. Kenney, Stanford University Press: 15-47.

[7] Leslie, S. (2000). The Biggest "Angel" of Them All: The Military and the Making of Silicon Valley. Understanding Silicon Valley : the anatomy of an entrepreneurial region. M. Kenney. Stanford, CA, Stanford University Press.

[8] Ibid.

[9] Varian Associates was founded in 1948 by brothers Russell and Sigurd Varian, with Russell holding a bachelor's and master's in physics from Stanford, along with the Stanford's physics department head at the time, Leonard Schoff, and Edward Ginzton, a professor of physics who had done undergraduate and PhD work at Stanford in physics, and several others. Varian Labs pioneered the klystron, which is a tube that can amplify electromagnetic waves at microwave frequencies. Its technological specialties also included small linear accelerators to generate photons, and nuclear magnetic resonance technology. It held numerous contacts with the military, developing the fuse for atomic weapons, for example. Varian Associates was the first firm to occupy space in the Stanford Industrial Park in 1958, widely recognized as one of the initial sites from which Silicon Valley in its postwar form was born. Edward Ginzton, one of its founders and it's CEO for a time—considered one of the founding fathers of Silicon Valley—has an applied physics labs at Stanford named after him. The Ginzton Laboratory, which pursues research in

Hewlett Packard owed much of their growth to military contracts. Hoping to benefit from the local expertise, established East coast companies such as General Electric, Sylvania, and Zenith all set up outposts in the form of laboratories and production facilities in the Bay Area. Many spinoffs from these large companies provided a growing ecosystem of startup firms with specialized technologies and know-how.

Firms that were specialized while primarily selling to the government *then broadened to commercial areas* as procurement budgets decreased and the government became a more difficult customer, beginning in the 1960s. Some of the specialty firms such as Varian Associates suffered, but people left those companies went on to more successfully diversified companies such as Hewlett Packard and various semiconductor firms that became the core of Silicon Valley.[11]

4.3. M&A by Large Firms

Beyond purchasing the products and services of startup firms, large firms actively purchase startup firms themselves. This can be a way to acquire not only a specific service or technology, but also to acquire the entire capabilities of the firm to create the next new offerings—if integrated and incentivized successfully. It also precludes rivals from obtaining it as well, which can lead to bidding wars.

"quantum electronics, semiconductor lasers, picosecond pulse techniques, optical microscopy, tunneling and force microscopy, fiber optics, condensed matter, superconductive materials and their microwave applications, and acoustic techniques for nondestructive evaluation of semiconductors and other materials." (https://ginzton.stanford.edu/history)

[10] Watkins-Johnson is described as the most financially successful of the Stanford spinoffs in the early postwar period. Co-founder Dean Watkins was a Stanford professor, and Watkins-Johnson, located in Stanford Industrial Park, developed and manufactured microwave tubes, mostly for surveillance, reconnaissance, countermeasures, and telemetry. These technologies came from Watkin's research efforts at his Stanford lab. "Founded in 1957, sales in 1958 were $500,000, growing to $4.6 million in 1961, $9.5 million in 1963, and $16.8 million in 1966." Leslie, S. (2000). The Biggest "Angel" of Them All: The Military and the Making of Silicon Valley. Understanding Silicon Valley : the anatomy of an entrepreneurial region. M. Kenney. Stanford, CA, Stanford University Press.

[11] Lenoir, T. (2014). Inventing the entrepreneurial university: Stanford and the co-evolution of Silicon Valley. Building Technology Transfer Within Research Universities: An Entrepreneurial Approach. T. J. Allen and R. P. O'Shea. Cambridge, UK, Cambridge University Press**:** 88-128.

Figure 3.

Year	Number Total	Number Known	Price ($Mil)	Average ($Mil)	Mean time to Exit (Years	Median Time to Exit (Years)
1985	7	3	300.2	100.1	7	4.8
1986	8	1	63.4	63.4	3.4	3.5
1987	11	4	667.2	166.8	4.9	3.5
1988	17	9	920.7	102.3	4.7	4.1
1989	21	10	746.9	74.7	4.3	3.6
1990	19	7	120.3	17.2	5.8	5.5
1991	16	4	190.5	47.6	6	5
1992	69	43	2119.1	49.3	4.7	4
1993	59	36	1332.9	37	5.3	4.7
1994	84	57	3208.4	56.3	5.8	5.3
1995	92	58	3801.8	65.5	4.6	4.1
1996	108	76	8230.8	108.3	5.2	4.1
1997	145	100	7798	78	4.5	3.1
1998	189	113	8002	70.8	4.5	2.8
1999	228	155	38710.6	249.7	3.6	2.8
2000	379	245	79996.4	326.5	3.2	2.7
2001	384	175	25115.6	143.5	3	2.2
2002	365	166	11913.2	71.8	3.5	2.9
2003	323	134	8240.8	61.5	4.3	3.6
2004	402	199	28846.1	145	5	4.6
2005	446	201	19717.3	98.1	5.4	5.2
2006	484	208	24291	116.8	5.7	5.7
2007	488	201	30745.5	153	5.8	6.3
2008	417	134	16236.9	121.2	5.8	5.6
2009	351	109	12364.9	113.4	5.7	5.5
2010	523	150	17707.3	118	5.8	5
2011	490	169	24093.2	142.6	5.8	5
2012	473	132	22694.2	171.9	6.2	5.6
2013	376	94	16586.5	176.5	5.9	5

Source: National Venture Capital Industry Association

Newly large firms—successful startups themselves within the past two decades—are particularly prominent in M&A deals. The recent economic boom in Silicon Valley has given these new firms that grew into large firms, such as Amazon, Google and Facebook, ample cash and stock valuations to aggressively purchase companies. It is noteworthy that Japanese firm Rakuten was one of the 2014 "mega-deal" purchasers. The 19 billion dollar purchase of

WhatsApp, a mobile message application, by Facebook, was particularly noteworthy since the amount was far greater than almost every other.

Figure 4. Significant Large M&A Deals in 2014 Involving Startups

Firm Sold	Acquired By	Estimated Amount	Service Description
WhatsApp	Facebook	$22 billion	Free mobile messenger and social networking app
Trulia	Zillow (Merger)	$3.5 billion	Online real estate portal
Nest Labs	Google	$3.2 billion	Internet controlled thermo-stats/smoke alarms with extensive data collection
Beats Electronics	Apple	$3 billion	High-end headphone manufacturer with online music store
Oculus	Facebook	$2 billion	Virtual reality headsets
Twitch	Amazon	$970 million	Gaming video platform
Viber	Rakuten	$900 million	Free messenger/phone call app
Divide	Google	$120 million	Mobile productivity app
Convertro	AOL	$101 million	Cross-platform advertising analytics software

Source: http://www.inc.com/jeremy-quittner/ten-top-exits-of-2014.html

Cisco Systems played a major role in pioneering the new Silicon Valley industrial model during the 1990s of using M&A to rapidly acquire new technologies and capabilities, without owning its own manufacturing facilities.[12] Cisco was founded in 1984, with two of its three founders being computer operations employees at Stanford.[13] Cisco rode the wave of the world's explosive growth of demand for Internet networking equipment, dominating global markets from the mid-1990s onwards. Its innovation model was to aggressively purchase companies and technologies from outside rather than develop them in-house. For example, it purchased nine in 1998, 23 in 2000, and 11 in 2012. It also chose to outsource virtually all of its manufacturing, focusing on design and freeing it from owning and operating physical manufacturing facilities. In 2000, though at the top of the US "dot-com boom," Cisco had the highest market capitalization in the world. In 2014, it remains one of the largest market cap firms and a major presence in Silicon Valley.

[12] Surgeon calls this "modular production," describing how the American model of production was shifting towards one of modular production networks, with large companies limiting their core activities and making use of outsourced R&D and manufacturing. Sturgeon, T. J. (2002). "Modular production networks: a new American model of industrial organization." Industrial and corporate change **11**(3): 451-496.

[13] Although Stanford initially apparently considered suing the former employees for what it considered as theft of its software, hardware, and intellectual property surrounding networking, it later licensed router software and computer boards to Cisco, in 1987.

4.4. US Production Transformation into "Open Innovation" – a Partial Result of Japanese Manufacturing Success

In understanding why large firms in the US provide crucial early markets for startups' services and products, and often buy startups themselves, we must look to the radical transformation of large corporations in the US. Interestingly, the transformation was significantly driven by the success of Japanese firms in manufacturing.

Until the 1980s, US large corporations resembled what we now think of as the traditional Japanese large firm model. Lifetime employment was the norm at large blue-chip companies such as IBM, HP, AT&T, General Electric, oil companies, and the Big 3 auto companies, for example. The innovation models were based on in-house R&D, with AT&T's Bell Laboratories leading the way in basic and applied research, investing in a wide range of technologies including transistors, motion pictures, television, stereophonic sound, and laser technology. CEO compensation was not tied to companies' share prices on the stock market, and institutional investors did not have a major say in corporate governance. Companies tended to be vertically integrated, controlling most aspects of their supply chains themselves.

After the oil shocks hit the US, and the US economy experienced years of stagnant growth combined with inflation, many large US firms faced dire financial straits. They were outcompeted by Japanese manufacturing firms, particularly from the early 1980s, and the US economy seemed far from recovery. In this context, large firms in the US that survived engaged in a major transformation of how they operated.

IBM was perhaps the most dramatic example, as it neared bankruptcy in the late 1980s and early 1990s. Its new CEO, Louis Gerstner, appointed in 1993, transformed many of the operating tenants of the company, jettisoning the norm of lifetime employment, engaged in major layoffs (about 100,000 in the first few years), and terminated or sold a wide variety of business areas, focusing on core businesses.[14] They began acquiring other companies and services, departing from their longstanding norm of relying almost exclusively on in-house products and services. IBM shut down its PC hardware division, then later sold its notebook PC division. It halted development of its operating system, OS/2 that was losing badly to Windows despite many arguing that it was a technically superior product. Gerstner, who was recruited from outside the company after successfully turning around American Express, replaced a CEO that had been promoted from within IBM, as had many of the top managers. He was also the first CEO to receive a very large compensation package, tied to the company's performance and aligned with the interests of shareholders. The fortunes of IBM then turned around, and it

[14] For example, despite having an operating system, OS/2 that many argued was technically superior to Microsoft Windows at the time, OS/2 had almost no market share. While IBM's previous CEO and other executives, who had risen from within IBM, were unable to let it go, Gerstner had no qualms about shutting down the program. He also presided over shutting down the PC hardware division, and later set the stage for selling the notebook computer division to Lenovo. Instead, Gerstner focused on providing integrated IT services to corporations, leading to a dramatic rebound of IBM.

retained a strong position in the IT industry—though never dominant as it had been during the postwar era of mainframe computers.

IBM, though one of the most dramatic, was not alone in its transformation. Although AT&T was split up due to a settlement in an antitrust suit brought by the US Department of Justice, it kept Bell Labs. However, it spun out the manufacturing arm, along with Bell Labs, which became Lucent. Lucent eventually essentially dissolved Bell Labs, ending an era of the major US corporate R&D labs that covered a wide range of basic and applied research.

The transformation of US corporate practices was nothing short of part of a deep shift in the structure and logic of its political economy and core innovation system. Economist William Lazonick has described this transformation as a shift from the Old Economy Business Model (OEBM) to a New Economy Business Model (NEBM).

Figure 5. Old Economy Business Model (OEBM) and New Economy Business Model (NEBM) in the Information and Communications Technology (ICT) Industries

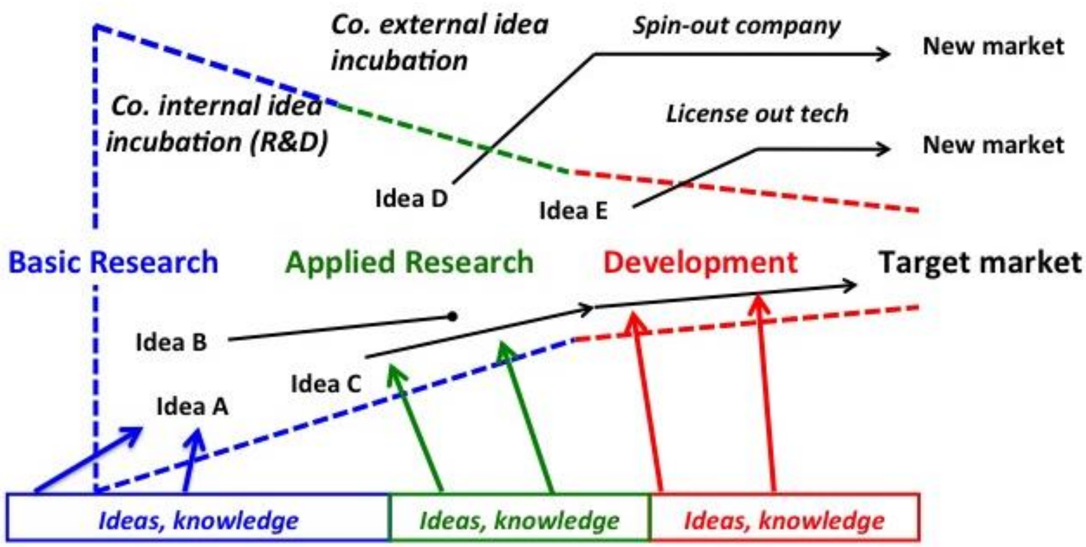
	OEBM	**NEBM**
Strategy, product	Growth by building on internal capabilities; business expansion into new product markets based on related technologies; geographic expansion to access national product markets.	New firm entry into specialized markets; sale of branded components to system integrators; accumulation of new capabilities by acquiring young technology firms
Strategy, process	Corporate R&D labs; development and patenting of proprietary technologies; vertical integration of the value chain, at home and abroad.	Cross-licensing of technology based on open systems; vertical specialization of the value chain; outsourcing and offshoring.
Finance	Venture finance from personal savings, family, and business associates; NYSE listing; payment of steady dividends; growth finance from retentions leveraged with bond issues.	Organized venture capital; initial public offering on NASDAQ; low or no dividends; growth finance from retentions plus stock as acquisition currency; stock repurchases to support stock price.
Organization	Secure employment: career with one company; salaried and hourly employees; unions; defined-benefit pensions; employer-funded	Insecure employment: inter-firm mobility of labor; broad-based stock options; non-union; defined-contribution pensions;

	medical insurance in employment and retirement.	employee bears greater burden of medical insurance.

Source: (Lazonick 2009)

A highly popular conception of "open innovation," articulated and popularized by Henry Chesborough, describes the result of the pervasive shift in innovation by large US companies.[15]

Figure 6. Open Innovation by Henry Chesborough



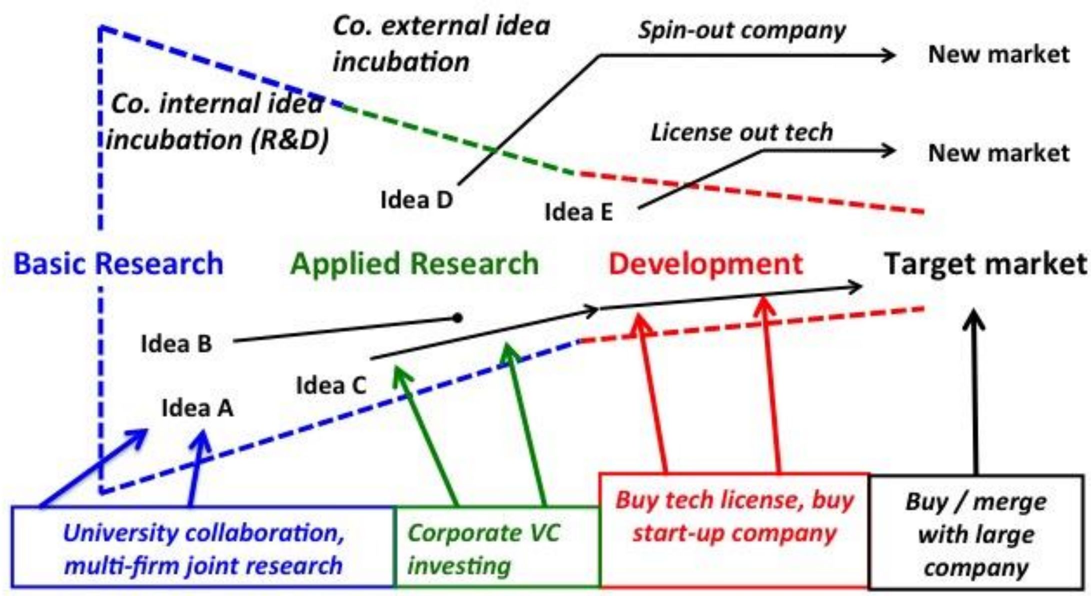
Source: Adapted from Chesbrough (2003)

In the traditional innovation system, all phases of innovation—basic research, applied research, development, and commercialization—took place within corporate boundaries. As the US innovation system transformed, the corporate boundaries became more porous. Companies increasingly brought in ideas and technologies from outside the company. They also became more aggressive in spinning out existing ideas from within the company. As Richard Dasher contends, university collaboration and multi-firm joint research began to play a bigger role in basic research, corporate venture capital investing became more important in applied research,

[15] Chesbrough, H. W. (2003). Open innovation : the new imperative for creating and profiting from technology. Boston, Mass., Harvard Business School Press.

the purchase of technology licenses and startup firms grew significant for development, and buying and merging became important in the commercialization process.

Figure 7. Open Innovation and Sources of Ideas, Stages of Investment



Source: Richard Dasher (2013)[16]

[16] Dasher, R. (2013). "Disruptive Ideas, Open Innovation, and New Value Chains: Trends in Asia." Retrieved June 15, 2014, from http://asia.stanford.edu/us-atmc/wordpress/wp-content/uploads/2013/10/131003-Dasher-EE402A.pdf.

5. Financial systems in Silicon Valley: Venture Capital and Value Added

For Japanese companies interested in accessing Silicon Valley, the system of venture capital needs to be understood. Especially with recent interest in creating Corporate Venture Capital (CVC), in which the corporation puts up the funds rather than venture capitalists gathering funds from investors, the *value-added functions provided by Silicon Valley venture capitalists beyond funding* are critical to note.

5.1. Venture Capital: How it works

The core of Silicon Valley funding centers around venture capital.

How does Silicon Valley venture capital work in its current form? Venture capital is premised on the idea that a portfolio of investments in early stage firms can generate enough capital gains that investors into venture capital funds can realize substantial returns. Since venture capitalists' stakes in companies are in the form of equity, they are far more risk-tolerant than banks in making loans. Traditional bank lending does not enjoy the capital gains upside, while the loan amount can be at risk. Venture capitalists, on the other hand, can enjoy substantial capital gains. Therefore, traditional bank lending is far more risk averse.[17]

Since the large majority of their investments would fail, venture capitalists evolved to demand involvement in their portfolio companies' management. They usually take representation on the firm's board, sometimes becoming chairman. By being active in introducing (or forcing) their human capital networks to startups they have invested in, successful VCs can actively help startups grow (see Box 1).

The most successful "homerun" VC investments tend to be those in which the growth potential is unexpected, and unforeseen by other investors. If the value can be judged correctly, then valuations in financial markets could be placed. It is this nature of foreseen unexpected future from which VCs derive great upside value.[18]

VC exits come in the form of M&A or Initial Public Offerings (IPOs). They have to dispose their stake in the firm to realize the upside gains of the investment to distribute to their investors.[19] Typical VCs take 2 to 3 percent of the total capital invested as a management fee, along with about 20 percent of the capital gains. The rest is returned to investors.

---

[17] Kenney, M. and R. Florida (2000). Venture Capital in Silicon Valley: Fueling New Firm Formation. Understanding Silicon Valley : the anatomy of an entrepreneurial region. M. Kenney. Stanford, CA, Stanford University Press: 98-123.
[18] Ibid.
[19] Ibid.

Box 1: Examples of "Hands-on" VC for a startup firm

For example, a Japanese startup at an early stage of development that entered Silicon Valley offering specialized Japanese and Chinese language document search services for law firms during litigation—which can create the need to search through hundreds of thousands of documents, benefitted greatly from VC-introduced personnel. Since its services were marketed towards law firms, it became quickly obvious to the VC that the firm needed to have the top sales manager be somebody who had interpersonal networks in law firms. The VC appointed this type of person, who was far more effective than his predecessor, leading to a rapid increase of sales.

In another example, the founder and president of a successful startup firm was frustrated when the VC forced him to sell his company off to a larger competitor. The startup had been enjoying robust growth, and was projected to catch up to the competitor in a few years if things continued smoothly, and the employees had been motivated around the rallying call of catching up and surpassing the competitor. However, the VC firm's other investments were not performing as well as they had hoped. In order to deliver sufficient returns to their limited partners (investors), the VC decided to exit this particular startup and get the highest valuation it could. The sale was successful and the founder became wealthy, but when interviewed a few years later he was still bitter that he was forced to sell his company at what he considered too early due to the VC's decision based on other investments.

What is the size and distribution of VC investments in the US? The following table shows the total amount geographic distribution of VC investments in the US in 2013. The total nominal dollar amount was approximately 23 billion USD. Over half was in California, with 14.8 billion, with Massachusetts and New York, second and third respectively, with 3.1 and 2.9 billion, respectively.

Figure 8. Total US and Top 5 States for VC Investments, 2013

State	# of Companies	# of Deals	Invested ($Bil)
California	1,362	1,616	14.8
Massachusetts	307	364	3.1
New York	344	403	2.9
Texas	134	154	1.3
Washington	107	126	0.9
Total*	2,254	2,663	23

Source: National Venture Capital Industry Association

Figure 8 breaks down the amounts of venture capital investment by region in 2013. This shows that Silicon Valley, with 12.2 billion USD, comprised most of California's 14.8 billion. It confirms that Silicon Valley leads the US in VC investments by a large margin. This figure begins after the recovery following the 2007 financial crisis, showing a robust rebound in VC investment.

Figure 9. Venture Capital Investments by Region 2009-2013, (millions USD)

Region	2009	2010	2011	2012	2013
Silicon Valley*	8,263.4	9,436.2	12,037.2	11,237.6	12,225.7
New England	2,603.7	2,577.9	3,344.5	3,391.6	3,307.7
NY Metro	1,748.9	1,872.8	2,862.5	2,366.9	3,194.7
LA/Orange County	1,080.9	1,687.8	2,076.7	2,092.5	1,748.2
DC/Metroplex	684.3	973.9	1,014.0	756.8	1,545.9
Texas	678.2	1,079.4	1,622.4	948.9	1,315.5
Southeast	1,032.00	1,101.2	1,193.4	801.1	1,293.9
Midwest	952.3	1,368.2	1,554.1	1,436.8	1,107.3
Northwest	673.9	728.9	785.4	998.5	1,056.7
San Diego	939.5	881.2	928	1,191.6	767.7

Source: National Venture Capital Industry Association*

* The National Venture Capital Association is somewhat vague in defining Silicon Valley as "Northern California: Bay Area and coastline," which is quite broad and includes what we define as the broader Silicon Valley region.

Venture capital investments are commonly divided into stages. Today, venture capitalists often specialize in a particular stage. The first round of funding for startups can often come from wealthy investors known as "angels." The earliest stage of venture capital investments, known as seed funding, are usually to start up and get the company going. Following that are early stage, expansion, and later stage investments, according to the typology of the National Venture Capital Association. The stages following seed funding, in which preferred stock is offered to VCs are commonly referred to as Series A, B C, and so on. Figure 9 provides a sense of the relative magnitudes of VC investments in each stage.

Figure 10. Venture Capital Investments by Stage (2006-2013)

Stage	2006	2007	2008	2009	2010	2011	2012	2013
Seed	1292	1837	1923	1735	1676	1079	836	966
Early	4770	6087	5889	4941	5914	8927	8315	9896
Expansion	11124	1066	10725	6841	8707	9829	9447	9814
Later	10329	2953	11412	6769	7072	9894	8754	8869
Total	7515	1943	29949	20286	23369	9730	27352	29545

Source: National Venture Capital Industry Association

Seed funding is unsurprisingly the smallest amount, since firms do not need as much in the initial stage. Particularly with the advent of Cloud computing, startup firms no longer need initial investments into datacenters or expensive software tools—computing resources such as processing power, storage, and data networking capabilities are available as pay-as-you-go services. Powerful software tools are also available as services, allowing startup firms to radically reduce software and computing costs (including technical experts just to manage the computer systems) up front.[20]

Early stage funding has been growing steadily along with the rise of startup "accelerators," formerly commonly known as incubators. The most famous and successful Silicon Valley accelerators is Y Combinator, founded in 2005, with notable successful companies including AirBnB, Dropbox, and online payment firm Script. Y Combinator takes relatively small equity positions while providing early funding, and an intensive mentoring program that gathers promising startups from all over the world to Silicon Valley, providing mentorship, advising, and an environment for entrepreneurs to focus "without distractions."[21] The success of Y Combinator helped spark a large number of incubators and accelerators, including some with high visibility such as 500 startups, founded in 2010, which also took batches of growing size (12 as its first, and 34 by 2011), investing in over 500 companies by 2013. As of 2014, Y Combinator receives thousands of applications from around the world, which are then narrowed to about 400 teams, who are flown into Y Combinator and interviewed for 10 minutes each. Out of these, about 100 are chosen.[22]

Expansion and later stage venture capital funding involves larger investments in to a smaller number of firms that succeed into this stage. Major VC firms, including many corporate venture capital firms, are big players in this stage. While the potential growth is limited compared an early stage investment, firms that make it into the later stages are also less likely to fail, providing a different risk-return profile. A typical later stage VC will go to the "demo day" of accelerators such as Y Combinator, in which firms present their business to potential investors. The later stage VCs then conduct their own analysis and engage in intense internal debates among partners to select a few in which to invest. At some VC firms, the limited partners who invest into the firm will have a seat at the table to have a voice in investment decisions.

Who are the investors in VC firms? Large pension funds and corporations tend to be the main investors. VC firms take the legal form of limited liability companies, and investors are limited partners (LPs).

5.2. Venture Capital: How did it develop?

In order to understand why VC works the way it does, and to derive lessons from it, we must examine how it developed, since the data show that it is a highly geographically concentrated industry. So how did it develop?

---

[20] Kushida, K. E., J. Murray and J. Zysman (2013). "Clouducopia: Into the Era of Abundance." CLSA Blue Book **January**, Kushida, K. E., J. Murray and J. Zysman (2015). "Cloud Computing: From Scarcity to Abundance." Journal of Industry, Competition and Trade.

[21] Tan, G. (2014). Making Things People Want. Stanford University, Stanford US-Asia Technology Management Center.
https://mvideos.stanford.edu/Graduate#/SeminarDetail/Autumn/2014/EE/402A/5463

[22] ibid

Venture capital had grown to a sizable industry by the early 1970s, propelled by significant returns by prominent early VC firms. The model of limited partnerships had become the modus operandi, with investors becoming limited partners in funds managed by VCs. The pioneering venture capital-funded firm was Fairchild Semiconductor, which was founded by a group of eight scientists (many with Stanford backgrounds), who left Shockley Semiconductor, founded by William Shockley who had invented the semiconductor, and which moved to Palo Alto in 1956. (The eight who joined and then left Shockley Semiconductor ended up founding 65 firms total.) When Fairchild was founded in 1957, the founders had relatively little equity shares, contributing to the departure of Robert Noyce and Gordon Moore, who left in 1968 to found Intel. Working closely with enterprising law firm Willson, Sonsini, Goodrich, and Rosati (WSGR), who were specialized on startups, Intel adopted a model that became the model for later startups, giving founders significant equity.[23] (Decades later, the CEO of WSGR, John Roos, became the US Ambassador to Japan.)

Venture capital grew alongside the US postwar electronics industry, which exhibited characteristics that differed substantially from traditional industries. The industry experienced waves of innovation characterized by Kenney and Florida as follows:

> …even as one electronics sector stabilized with a dominant design, a stable set of market participants, and a predictable incremental trajectory, new sectors appeared or the dominant design experienced significant disruptions, often due to the invention of new business models. (Kenney and Florida 2000, p.100)[24]

Precisely because these waves of disruptive innovation began, venture capital started to evolve into its present form, with venture capitalists investing in portfolios with the understanding that the majority would fail, with just a few rapid growth companies from which they could benefit from capital gains.[25]

The major investors into venture capital became pension funds in the late 1970s. This was driven by regulatory change. The Employment Retirement Income Security Act (ERISA) was passed in 1974, restricting corporate pension funds from holding certain types of investments considered risky. In 1978, ERISA restrictions were relaxed by the US Labor Department, enabling pension funds to invest in venture capital. This created a massive inflow of funds to venture capital, causing the VC industry to grow rapidly.

[23] Kenney, M. and R. Florida (2000). Venture Capital in Silicon Valley: Fueling New Firm Formation. Understanding Silicon Valley : the anatomy of an entrepreneurial region. M. Kenney. Stanford, CA, Stanford University Press**:** 98-123.
[24] Ibid.
[25] Ibid.

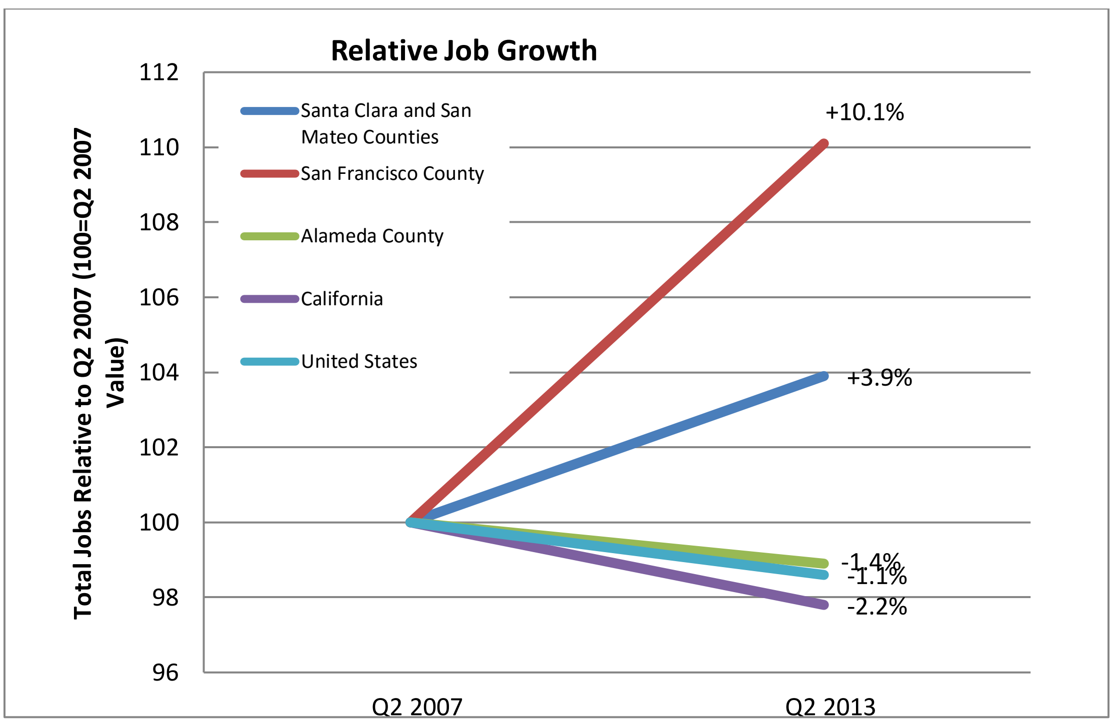
6. Labor Markets and Employment Systems

The deep talent pools available in Silicon Valley, and their dynamic circulation among various types of firms, startups, and universities are one of the strengths of Silicon Valley. The question for Japanese firms is how to tap into this labor market. Before formulating strategies and illustrating the challenges later on, we must first introduce how the labor market looks.

The performance of Silicon Valley's job market is in stark contrast to that of the rest of the US, and that of California in general. As seen in Figure 11, the job growth in Santa Clara and San Mateo Counties in 2013 grew 10 percent compared to the second quarter of 2007, just before the global financial crisis hit in the fall of 2007. San Francisco's job growth during the same time period was 3.9%, compared to a contraction of 2.2% for California as a state, and 1.4% for the US overall. Alameda County in the East Bay, which is on the geographic periphery of Silicon Valley, where many people in middle tier white-collar jobs in Silicon Valley coexist with an independent economy with a significant non high-tech economy, experienced a 1.1 percent contraction.

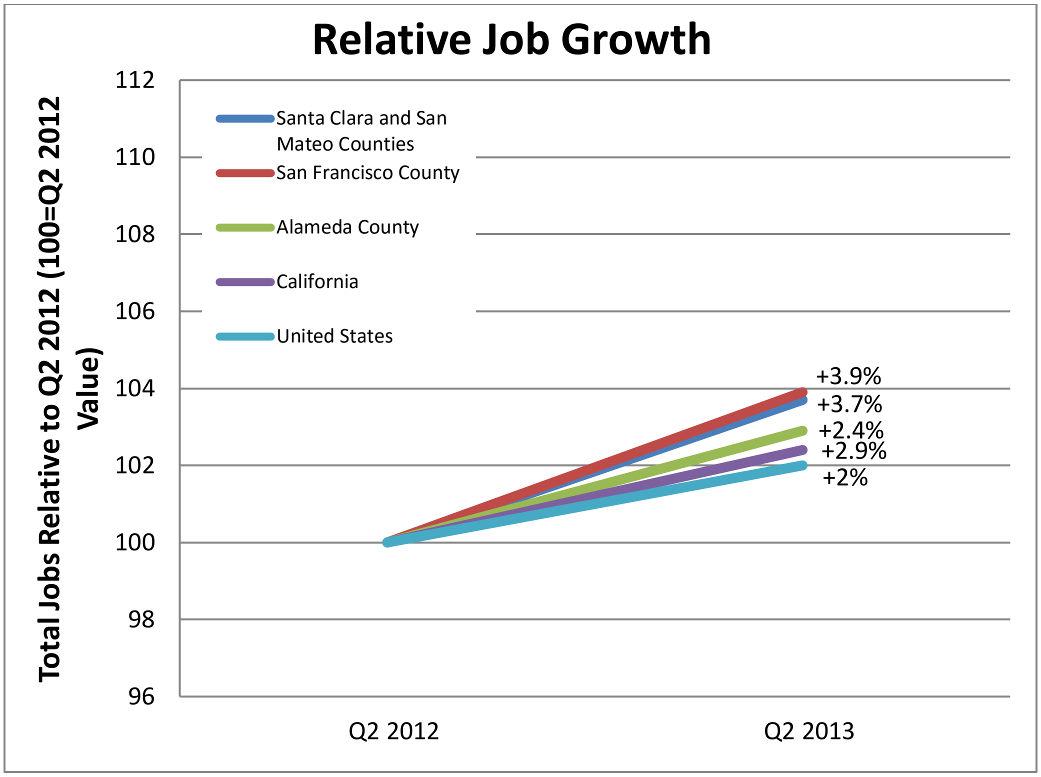
From 2012 to 2013, the core Silicon Valley counties and San Francisco's growth outpaced those of California and the US overall. Notably, Alameda county, while growing more slowly than the core Silicon Valley counties and San Francisco, did grow faster than California and the US overall, demonstrating the spill-over of Silicon Valley growth pulling up employment.

Figure 11. Relative Job Growth in Silicon Valley and San Francisco vs CA, USA (1)



Source: National Venture Capital Association, citing US Census Bureau

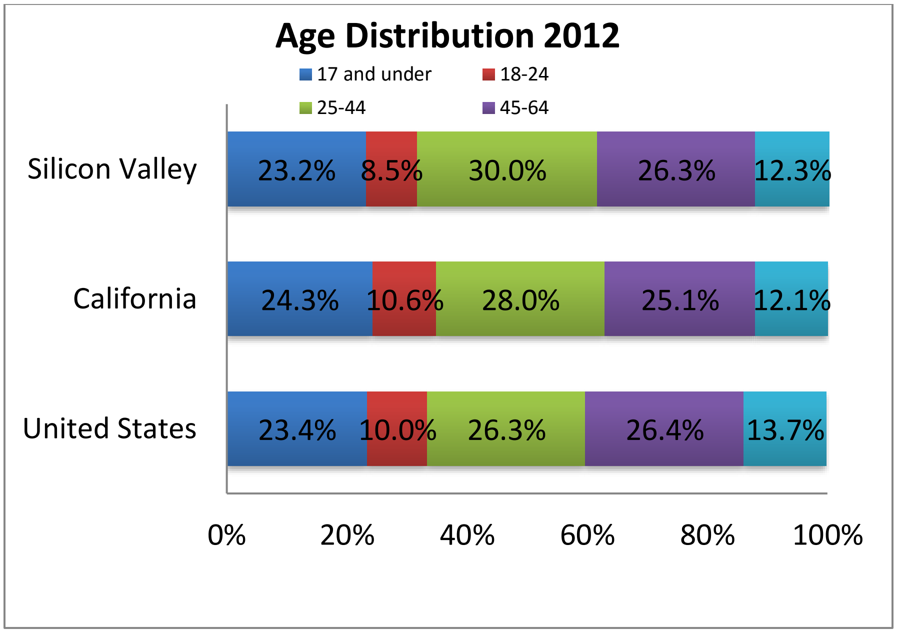
Figure 12. Relative Job Growth in Silicon Valley and San Francisco vs CA, USA (2)



Source: National Venture Capital Association, citing US Census Bureau

The age distribution of Silicon Valley is not much different from that of California and the overall US. The largest proportions of the population are of the working ages of 25-44 and 45-64, respectively.

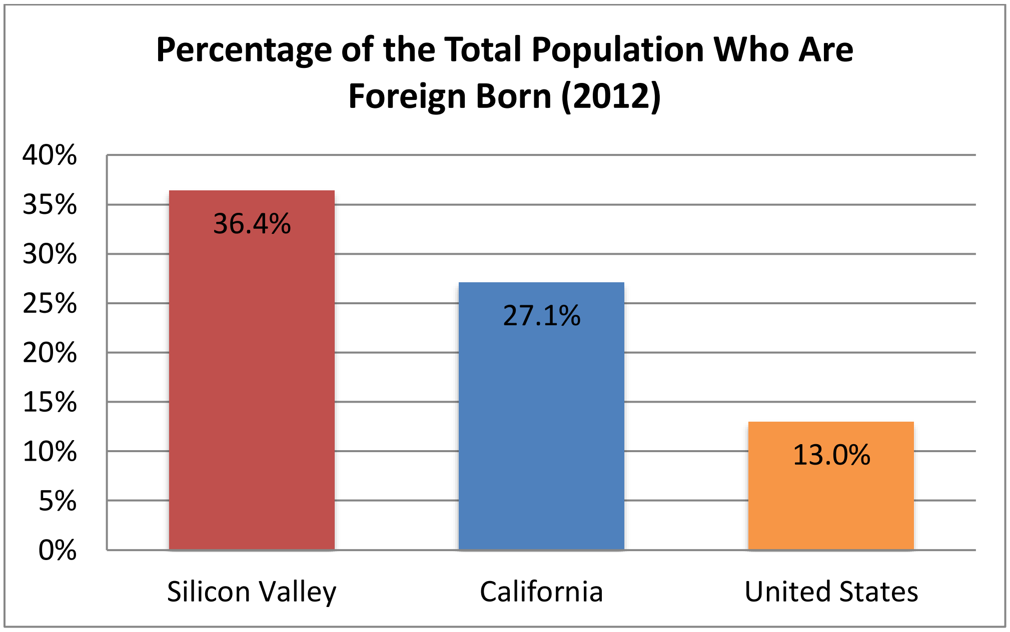
Figure 13. Age Distribution in Silicon Valley, California, and US, 2012



Source: National Venture Capital Association, citing US Census Bureau

The positive role of immigrants, particularly those with high-end skills, has been a dramatic feature of Silicon Valley. To take a recent snapshot, the percentage of foreign born population in Silicon Valley was 36.4% in 2012, exceeding that of California overall (27%), and is almost three times that of the US average (13%).

Figure 14. Total population who are foreign born



Source: National Venture Capital Association, citing US Census Bureau

What are the effects of these immigrants? Saxenian has argued that Silicon Valley has continually benefited from flows of immigrants from various areas of the world that create bridges with the economies of their home countries.[26] Silicon Valley therefore benefits from ties to places such as Israel and their strong software and intellectual property creation; cross-national production networks co-evolved with places like Taiwan, where entrepreneurs and scientists from Silicon Valley created fab-less semiconductor plants to facilitate Silicon Valley's specialization on design[27]; a flow of people from India created the ties that enabled business process outsourcing for back-office tasks and software co-creation to the Indian subcontinent; flows of Chinese from the Chinese diaspora and mainland China itself created bridges to form cross-national production networks.

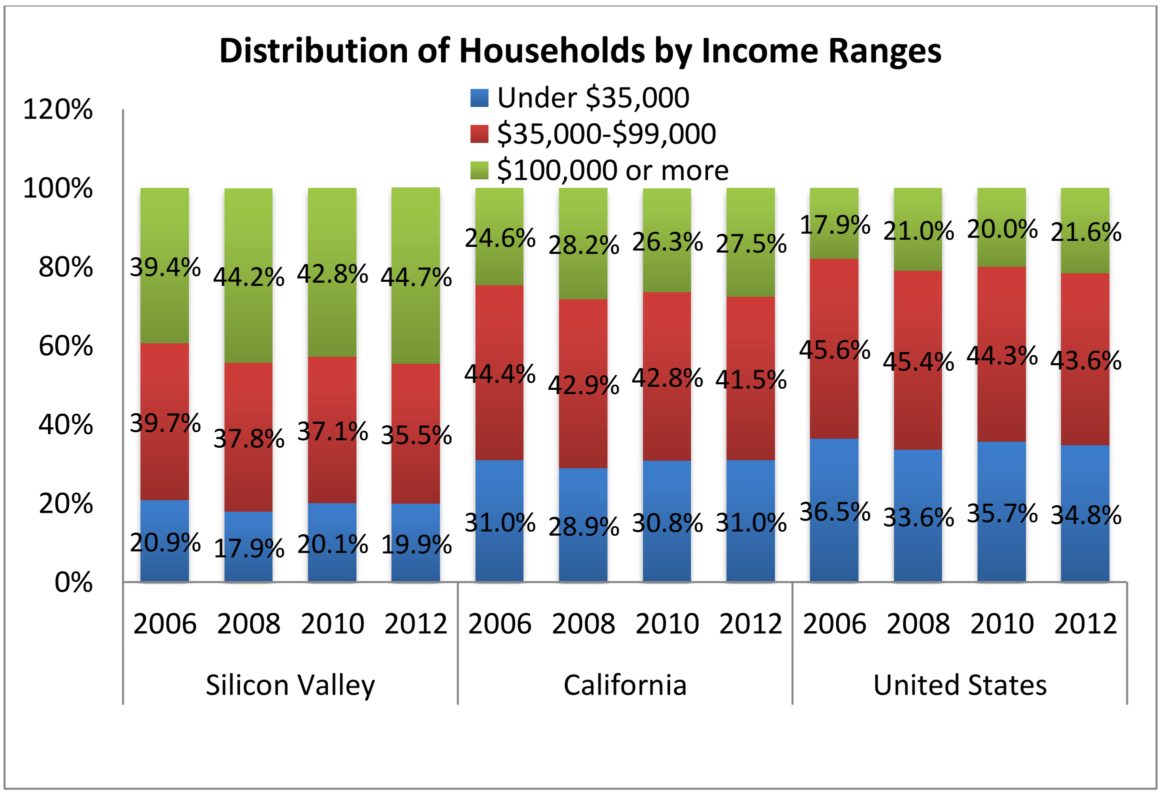
There are at least two policy points directly relevant to Japan from here. First, it is unrealistic to hope to duplicate this level of taking top talent from the rest of the world. While calls for opening certain job types to greater immigration are increasing in Japan, it is almost

[26] Saxenian, A. (1994). Regional advantage : culture and competition in Silicon Valley and Route 128. Cambridge, Mass., Harvard University Press, Saxenian, A. (2006). The new argonauts : regional advantage in a global economy. Cambridge, Mass., Harvard University Press.

[27] Chenming Hu illustrates this. After an undergraduate degree in National Taiwan University, he pursued a PhD in UC Berkeley, receiving it in 1973, and becoming faculty in the Electrical Engineering and Computer Science department in 1976. He was a decorated academic, making critical advances in semiconductors, publishing 4 books and over 900 papers, including co-authored ones, with over 140 patents granted. He founded a semiconductor design company in the 1990s, and become CTO of TSMC, the world's largest fabless semiconductor firm in Taiwan in the early 2000s.

impossible to envision this level of attracting global talent. Therefore, instead of only trying to increase inflows of highly skilled immigrants to Japan, making use of the Silicon Valley focal point to make connection to the rest of the world should be pursued in parallel. There are numerous types of policies that could facilitate increase in the presence of Japanese in Silicon Valley, including lobbying for easier visa treatment for early startups. Second, the point about Silicon Valley having a large and beneficial foreign-born population of high performing workers is that *Silicon Valley can act as an access point to talent from the rest of the world*. Sometimes going through Silicon Valley can put entrepreneurs and firms in touch with a more valuable network in other parts of the world rather than going directly.[28]

Figure 15. Distribution of Households by Income Ranges (2006-2012)



Source: National Venture Capital Association, citing US Census Bureau

The region's population growth has accelerated over the last year due to a 52 percent increase in foreign immigration in 2013 over the previous year. The region's total population grew 1.31 percent last year compared to 0.88 percent statewide, and our net migration (13,766 people) has not been this high since 1997 when it reached a high of 14,515. (SV Index P.8)

[28] "Innovations" 2015

6.1. Diversity of Employment Systems and Philosophies

There is a diversity of employment philosophies and compensation systems in Silicon Valley. In order to attract high quality talent, Japanese firms need to be aware of the various mechanisms and design appropriate internal organizations to create attractive employment environments. This is usually one of the most difficult challenges for Japanese companies with centralized, powerful personnel departments.

Silicon Valley companies are also continuously experimenting with effective philosophies and compensation schemes.

Stock options are often one of the most focused-upon aspects of compensation for startups. Yet, for companies that have already grown fairly large, the stock is already quite diluted, and may not promise high payoffs. Therefore, high wages based on performance are often used. This has the effect of pushing up wages, making Silicon Valley talent extremely expensive vis-à-vis the rest of the world. This raises several challenges for Japanese firms attempting to best utilize the ecosystem.

First, local Silicon Valley offices become responsible for screening and interviewing candidates, but employees of large Japanese firms usually have very little experience in doing this. There has been no single "best practice" for finding the best candidates, beyond the fact that many top management teams spend a great amount of time on recruiting. An interesting example for recruiting top management is from Google. When hiring a very senior position from IBM, Google instituted a strategy of having the people who would be working for the job candidate interview him. They presented him with very difficult, cutting edge theoretical problems in computer science that they were currently working on. They then assessed how he answered those questions—not just the answers, but how he approached the problems themselves. Then, convinced that he was somebody they wanted to work for, they gave an offer. Put simply, for hiring top management talent, evaluations were made from both above and from below the potential candidate.

Netflix represents an extreme example of how the corporate practices and norms surrounding employees differs significantly from large firms. Netflix has principles for fostering high employee morale that has made waves in Silicon Valley. In a 150-page slideshow Netflix lays out core principles, including the statement that there are no formal vacation days or expense accounts. The logic is that since employees regularly work late hours on weekdays and often on weekends as well, it does not make sense that they don't keep track of their working hours while they must report vacation hours to the company. Therefore, in 2003—even after it became a listed company—Netflix shifted its policy. For expense accounts, instead of having to justify each little expenditure and create layers of bureaucracy and rules, the company decided that it would trust its employees to ask the question, "is this in the interest of Netflix?" If yes, then they were free to use an expense account in a reasonable way. Overall, the company created a culture in which employees are judged by what they produce rather than how hard they work to produce it—a “B” level output worker, despite working extremely long hours and hard, can be let go, while an employee working far less can be rewarded if they produce “A+” output. For managers, the question of whether to keep employees on their team boils down to “would you fight for them if they got an attractive outside offer?” They applaud employees who find new opportunities elsewhere, and believe that those they would like to retain deserve high salaries. Rather than have policies designed to manage the 3% of troublesome workers, they try to not hire, or quickly get rid of the 3% that do cause problems. Moreover, in some cases, being forthright about letting go of employees that had produced excellent work but no longer fitted the need of the company as it grew to become public, and offering them generous severance packages turned out to be effective morale boosters. Bonuses were also not based on performance, since the idea was that if the hires were successful, individual performance bonuses should be compensated for by competitive wages.[29]

Second, for startups, the variety of employment and compensation schemes can be extensive. For example, certain star programmers may prefer to remain contractors. Some might prefer larger cash salaries and fewer stock options, while others prefer the reverse. Some companies, such as Netflix, allow employees to choose the mix, entrusting employees to make their own decisions based on what they calculate to be in their best interest given their individual levels of risk-aversion, family, et cetera.

When purchasing and integrating companies with such diverse employment philosophies and compensation schemes, it is a challenge for any company—especially Japanese large corporations—to assess how best to manage the new company. Rakuten, for example, tends to leave the purchased companies maintain their own individual identities and cultures, aiming to own a portfolio of companies rather than integrating them completely into its own culture. DeNA, after purchasing ngmoco in 2010, did integrate it into its own culture. It was an exercise that led to a great deal of organizational learning. In terms of compensation, DeNA took the approach of offering profit and loss (PL) based bonuses. Since it had already IPO’ed in Japan and stock options would be highly diluted, it took the stance that the company’s PL should be the baseline for assessing performance worthy of a bonus. However, given the culture and expectation of potential employees to get stock options, it took time to convince many that PL was actually a good measure of the company’s actual performance.

For Japanese companies to most effectively utilize the Silicon Valley ecosystem, a reasonable amount of flexibility in the headquarters’ personnel division, with a relatively high level of autonomy granted to the Silicon Valley offices, is likely to bring better results than a centrally controlled system if it is not calibrated to accommodate Silicon Valley employment conditions. This is an area in which top management needs to understand the logic of Silicon Valley to provide support to the local operations.

[29] McCord, P. (2014) "How Netflix Reinvented HR." Harvard Business Review. https://hbr.org/2014/01/how-netflix-reinvented-hr

7. Roles of Government

Examining the role of the government in Silicon Valley is important when we consider potential policies for Japan to encourage the development of an innovation based economic growth. Studying the role of universities is also important because Japanese companies can potentially derive benefits from working with Silicon Valley universities such as Stanford and UC Berkeley. Moreover, the current government of Japan lists university reform as one of the policies to promote innovation in Japan.

7.1. Which Government?

The most crucial points in understanding the roles of government in Silicon Valley is that there is no "Silicon Valley" government, and *Silicon Valley was* ***not*** *created by strategic government policy*. Instead, it developed organically. This does not automatically mean that particular characteristics of Silicon cannot be duplicated elsewhere. However, it does mean that there is no particular set of "best practice" strategies that built Silicon Valley, which can be directly imported by other governments.

The key insight into the government and policy environment of Silicon Valley is the US government's federal structure, in which state policies over a variety of areas can differ considerably from one another.

7.2. Federal Government and California State

The role of the US Federal government in funding has already been explained above. An important facet to emphasize is that the major research programs by the US government, through institutions such as the National Institute of Health, National Science Foundation, and the military, have exerted substantial influence on the trajectory of scientific inquiry, and therefore the areas in which Silicon Valley has turned its attention. Universities have played a crucial role in transforming government investments into scientific knowledge, which is then taken by industry and applied towards commercial ends.

The two most significant **federal government** policy shifts that were critical preconditions for the growth of Silicon Valley venture capital were the relaxing of pension fund investment targets and a drastic lowering of the capital gains tax. These were outlined above as well. The *capital gains tax* was lowered from 49.5% to 28% with the 1978 Revenue Act. The early venture capitalists and American Electronics Association strongly supported this bill. The *relaxation of ERISA (Employment Retirement Income Security Act) restrictions* in 1979 by the US Labor Department under the "prudent man rule" allowed corporate pension funds to invest in venture capital, which was among the riskier asset classes. Pension funds quickly became the prime funder of venture capital, rising from 100-200 million USD per year in the 1970s, to over 4 billion by the late 1980s.[30]

---

[30] Kenney, M. and R. Florida (2000). Venture Capital in Silicon Valley: Fueling New Firm Formation. Understanding Silicon Valley : the anatomy of an entrepreneurial region. M. Kenney. Stanford, CA,

Other federal government programs such as the H1 *visa* program, a non-immigrant visa allowing US employers to temporarily hire technical skilled workers has facilitated bringing foreign talent into Silicon Valley. The cap for visas was increased significantly in 2000 with the American Competitiveness in the Twenty-First Century Act of 2000. It allowed the government to overshoot the cap by 20 to 30 thousand people, and increased the cap to 195 thousand between 2001 and 2003. It also provided an exemption to the cap for universities, non-profits, and government research organizations. Critically, a statute in the act allowed the sponsor of the visa or the employer to change. The visa provided a three-year term, extendable until six years with some exceptions.

Figure 16. H-1B Applications Approved by the US Citizenship and Immigrations Services

Year	Initial Applications	Renewals+Extensions	Total Granted
1999	134,411	na	na
2000	136,787	120,853	257,640
2001	201,079	130,127	331,206
2002	103,584	93,953	197,537
2003	105,314	112,026	217,340
2004	130,497	156,921	287,418
2005	116,927	150,204	267,131
2006	109,614	161,367	270,981
2007	120,031	161,413	281,444
2008	109,335	166,917	276,252
2009	86,300	127,971	214,271
2010	76,627	116,363	192,990
2011	106,445	163,208	269,653
2012	136,890	125,679	262,569

Source: USCIS

Japan ranks eighth among H1-B recipients' countries of birth, although the high percentage of Indian-born workers at 58% in FY2011 and 64% in FY2012 makes up a far larger number than Japan's 1.2% and 1.0% percent of total recipients. With visa problems cited as one of the hurdles for Japanese businesses and entrepreneurs building physical presences in Silicon Valley, negotiations to increase the allocation of H1-B visas to Japanese may be a reasonable lobbying effort for the United States' closest security strategic ally in the Asian region.

Stanford University Press**:** 98-123, Rao, A. (2013). A History of Silicon Valley: The Greatest Creation of Wealth in the History of the Planet, 2nd Edition.

Figure 17. H1-B Petitions Approved by Country of Birth, FY2011, 2012 (% of total)

Rank	Country of Birth	FY 2011	FY 2012
1	India	58.0	64.1
2	China	8.8	7.6
3	Canada	3.5	3.0
4	Philippines	2.8	2.0
5	South Korea	2.5	1.7
6	United Kingdom	1.7	1.3
7	Mexico	1.3	1.2
8	Japan	1.2	1.0
9	Taiwan	1.1	0.9
10	Pakistan	0.9	0.8
11	Germany	0.8	0.7
12	Turkey	0.8	0.7
13	Brazil	0.7	0.7
14	Nepal	0.6	0.6
15	Venezuela	0.6	0.6

Source: USCIS Characteristics of H1B Specialty Occupation Workers

California does not provide a low-tax environment. Forbes ranks each state annually using indicators including business costs, quality of labor supply, regulatory environment for business, economic climate, growth prospects, and quality of life. While some of these indicators are subject (especially if quality of life does not include weather, which is quite mild and popular in Silicon Valley), "business costs" are revealing. The report notes that California's economy is \$2.2 trillion, which would be the 8th largest in the world, and it comprises 13% of the US economy. Its ranking for cost of doing business is 46 out of 50 states, with 10% higher costs than the national average. Growth prospects, however, ranked at 3rd. (The two highest ranking states for growth prospects were Texas and North Dakota, largely based on the shale gas boom that was continuing at the time of the latest survey in 2014). California's overall ranking was 36 out of 50 states. Thus, if Forbes' indicators are reasonable, *Silicon Valley's success is despite a relatively high tax burden and cost of doing business*. This focuses our attention even more on the factors that do make Silicon Valley the origin of wave after wave of the world's innovation.

Figure 18. Forbes' "Best States for Business" California Rankings

	Business Costs	Labor supply	Regulatory environment	Economic Climate	Growth Prospects	Quality of Life
California	46	28	43	26	3	25

Source: Forbes, http://www.forbes.com/best-states-for-business/

Given the importance of state-level legal structures in the US federal system, the role of state-level policies and judicial decisions can significantly influence the regulatory environment. This is particularly true for *non-compete agreements, where California state law, supported by California courts, make provisions facilitating worker mobility*.

Non-compete agreements are often deployed by employers who wish to protect their intellectual property. They can potentially limit the mobility of workers through the fear of possible lawsuits. However, interestingly, non-compete agreements in the US are not governed by any federal law, making state-level legislation and judicial decisions the key factors for the effect of these agreements. California is one of a few states that specifically prohibit non-compete legislation.[31] Moreover, California's protections are particularly strong, with its Business and Professions Code including a provision saying that "every contract by which anyone is restrained from engaging in a lawful profession, trade, or business of any kind is to that extent void." This provision actually originated in 1872, very early in the state's history (California became a state in 1850, only three years before Admiral Perry's black ships arrive in Edo Bay). Yet, this provision was tested in and affirmed in numerous court cases, including one in 1998 that declared invalid the non-compete agreements of other states, and again in 2008.[32]

In fact, one of the historical developments that contributed to Silicon Valley being a center for innovation owes significantly to California's legal environment. The modular design of the IBM System/360 mainframe computer, introduced in 1964, enabled people to leave IBM to develop components that would plug into and be compatible with the S/360. IBM employees were initially fearful of legal action by IBM, but in California they were safe to pursue new businesses that relied upon their expertise gained at IBM, and working knowledge of the S/360. This helped the computer industry develop in Silicon Valley.[33]

Based on data from 1994-2001, researchers have found a California effect of high job mobility for certain IT industry jobs rather than only a Silicon Valley effect, suggesting state-level influence on software engineers' job mobility.[34] The same study with more recent data would be interesting.

7.3. Local Governments

As discussed earlier, the region's borders are not clearly defined, and they span multiple counties and cities. This directly affects infrastructure such as transportation and housing—mostly negatively. Many areas that try to build their own "[placename] Silicon Valley" tend to begin with the infrastructure of transportation, housing, and recently "smart city" infrastructure with intelligent electricity grids and a variety of IT-enabled infrastructure.

---

[31] Other states include Alaska, Connecticut, Minnesota, Montana, North Dakota, Nevada, Oklahoma, Washington, and West Virginia.

[32] These cases were the 1998 decision of Application Group, Inc v. Hunter Group, Inc. and 2008 California Supreme Court decision on Edwards v. Arthur Andersen.

[33] Baldwin, C. Y. and K. B. Clark (2000). Design rules. Cambridge, Mass., MIT Press.

[34] Fallick, B., C. A. Fleischman and J. B. Rebitzer (2006). "Job-hopping in Silicon Valley: Some evidence concerning the microfoundations of a high-technology cluster." The Review of Economics and Statistics 88(3): 472-481.

The broader Silicon Valley ecosystem, in contrast, suffers from a lack of public transportation infrastructure, overloaded highways, uncoordinated restrictions on housing supply, and zoning that makes it prohibitively expensive for much of the middle class to live in the high growth areas—*it is **not** the product of successful urban planning or and industrial zone*.

The Bay Area's public transportation network was not created by industrial policy per se, but was rather the product of a series of political compromises. The rail system BART (Bay Area Rapid Transit) is the best—and most unfortunate—example of this. Planning began in the early 1950s, with plans to seamlessly connect the entire Bay Area from San Francisco to San Jose on both sides of the bay in a large loop, including San Francisco International Airport, Oakland Airport, and San Jose International Airport, were vetoed by local politics. The counties initially participating in the planning involved included Alameda, Contra Costa, Santa Clara, San Mateo, and Marin. Critically, Santa Clara County exited in 1957, followed by San Mateo in 1961. Santa Clara's elected official were reportedly upset that the first stage of construction did not cover the entire county, but ended in Palo Alto, with extensions in the subsequent stages. San Mateo's exit was reportedly partly influenced by a real estate agent who convinced county supervisors that the train line would decrease potential property values along a newly constructed freeway. Although Marin County, across the Golden Gate Bridge from San Francisco, had voted for part with almost 90% of voters supporting it, the exit of San Mateo led to a major decrease in the tax base of BART—its critical funding support—making Marin county too expensive to connect BART. Marin therefore exited in 1962. As a result of failure to coordinate the adoption of BART across these separate counties, BART operated for almost 30 years without connections to the San Francisco International airport, limiting its usefulness. In the 1990s, although Santa Clara County passed sales taxes to extend a different light rail system to Fremont, extension across the bay was ruled invalid, and a different measure that passed to extend BART into Santa Clara County was later canceled.[35] The BART was also built with a proprietary rail gauge and electrical and control systems that differed from all other US systems, making system maintenance and upgrades costly.

The main public transportation system linking the heart of Silicon Valley and San Francisco is the Caltrain train system, which connects San Jose to San Francisco. Operated by a different public entity from BART, Caltrain runs only once an hour during non-peak hours and on weekends. It does not connect to BART in San Francisco. It also does not connect to the US long distance train line Amtrak, which connects the Bay Area to California's capital Sacramento, and beyond.

The point of these illustrations is to show that Silicon Valley suffers from lack of coordination among different local governments, whose potentially beneficial function of providing efficient public transit systems has been a failure. Many outsiders who view the

[35] (2005) "History of BART to the South Bay." San Jose Mercury News.

current situation assume that this reflects American culture of preferring cars to mass transit, but this is not the case. Santa Clara county residents did pass measures that were voted upon by the general public to increase taxes to improve the public transit system, but the counties were locked into political decisions reached in the 1950s and early 1960s in a decentralized manner.

As a result, companies such as Uber appeared in order to fill much needed demand for people to move easily around the Bay Area without their own car. The fact that Uber's 2014 revenue far exceeded that of the entire taxi industry in previous years suggests that rather than replacing existing demand for taxis, Uber is fulfilling untapped demand by users in search of an easy and relatively low-cost transportation solution.

Further evidence of the lack of coordination among counties and exploding demand in Silicon Valley include the housing situation. The area near Google headquarters in Mountain View, for example, has ordinances that prevent the rapid construction of new housing. Since public transportation was unreliable and the rapid growth of Google led to massive traffic jams in the area, Google began to use its own private buses to bring employees from San Francisco, Oakland, and other Bay Area locations to allow employees to be productive while commuting to work. However, the fact that these buses sometimes used public bus stops in San Francisco, and that the high incomes of Google employees and other tech firm workers were rapidly pushing up housing prices in San Francisco, which also had zoning and construction permit issues severely limiting the speed of new housing construction, led to a number of public protests. Thus, the rapid growth of Silicon Valley firms and their efforts to work around the lack of local government support and coordination has severely affected the local communities.[36]

With housing among the highest in the country, San Jose has been home to what most US media call the largest homeless encampment in the US.[37]

Thus, on the one hand, while Silicon Valley's success has been remarkable, it was not the result of strategic local government policy. It should be thought of as the forces that made Silicon Valley so successful were *despite the considerable disadvantages of lack of local government coordination and strategy*; therefore analyzing the ingredients that make the ecosystem successful become all the more important.

[36] Hogan, M. (2014) "Living in a Fool's Paradise." Boom: A Journal of California **4**.
[37] Fernandez, L. and N. Miranda. (2014). "Nation's Largest Homeless Encampment, "The Jungle," Dismantled." Retrieved January 20, 2015, from http://www.nbcbayarea.com/news/local/Game-of-Whack-a-Mole-Homeless-Upset-to-be-Evicted-by-Police-From-The-Jungle-in-San-Jose-284745461.html.

8. University-Industry, University-Government Ties

Universities are a critical component of the Silicon Valley ecosystem, serving as a multifaceted focal point for the exchange of human capital, ideas, technologies, and more. As such, Japanese companies that can effectively make use of universities for the variety of functions they can offer stand to benefit and become more effectively integrated into the Silicon Valley ecosystem. To do so, the first step is understanding the role of universities.

The relationship between the government, universities and industries is often misunderstood as unidirectional, with the government encouraging innovations at universities by providing funding and the universities producing new ideas that are commercialized by industry. The reality observed in Silicon Valley, however, is more complex and multi-directional. The efforts for innovation are more often driven by individual researchers at universities rather than the government agencies or university administration, and initial ideas for innovation often comes from industries.

The university-industries ties that contribute to the Silicon Valley ecosystem are multifaceted, diverse, and not easily captured by a single set of metrics. This in itself has caused much confusion for actors wishing to learn about Silicon Valley, not only from those outside the US, but in US media portrayals as well. This is partly because of the close relationship between the multifaceted university-government ties that anchor much of the university-industry ties.

The core research universities are Stanford University and the University of California. Among the University of California schools UC Berkeley and UC San Francisco Medical Center are within the broader Silicon Valley ecosystem, with UC Davis also playing an important role, particularly in agricultural science. Other universities in the area include Santa Clara University, San Jose State, San Francisco State, University of San Francisco, and numerous community colleges. Each play different roles in the Silicon Valley ecosystem, but here we focus on Stanford and UC Berkeley.

We should start with the overall US national context of US-industry ties, which most analyses begin with. There is a pervasive image that funding often flows from the government and industry into major research universities, which then patent commercializable technologies and inventions through a technology licensing office, which then spins out the intellectual property into the commercial sector, deriving major revenue for the university. The image of this system as successful has led to policies by governments around the world imitating this system. As we will see, this image is misleading; university-industry ties in the US are far more complicated, and this simple model in and of itself is not as successful as it may seem from the outside. The major successful research universities in Silicon Valley have far more complex and multidimensional relationships to industry. Therefore, simply copying this image of a "technology licensing office-centric university-industry coordination model" is not likely to succeed elsewhere.

8.1. The US Technology Licensing Model: Bayh-Dole

The US technology licensing model was legislated in 1980 with the Bayh-Dole Act, also known as the Government Patent Policy Act of 1980. It was passed in the context of grave concerns about the economic competitiveness of the US as its economy suffered from recessions and stagflation following the oil shocks beginning in 1971. The Bayh-Dole Act allowed the ownership of an invention from federal research funding to reside with the university, small business, or non-profit organization. Previously, ownership was required to go to the federal government. Given the government's $75 billion or so budget assigned to research in the 1970s, this was a game-changer, providing strong economic incentives to commercialize the products of research.[38]

However, the Bayh-Dole Act was *not* a strategic industrial policy in the sense that there was widespread political support. In fact, a very fragile political coalition of interests narrowly passed the measure despite the Carter administration's initial opposition.[39]

After Bayh-Dole was enacted, research universities almost all established technology transfer offices aimed to become a central hub for patents from universities to be discovered and used by industry, and to negotiate licensing arrangements. The degrees to which these were successful are mixed. We will introduce specific Stanford examples below, but a few notable points should be emphasized.

8.2. Multifaceted University-Industry Ties

First, s*imply counting academic patents or licensing revenues are poor measures* of the "performance" of universities in developing or transferring technologies and knowledge to industry. This is because of the *multifaceted and bidirectional* nature of industry-university interactions and knowledge flows that are observed in virtually all case studies of successful university-industry collaboration. In the area of university entrepreneurship, the data is extremely problematic, and significantly undercounts a variety of forms of academic entrepreneurship and influence of universities on startup ecosystems.[40]

The university-industry relationships are multi-faceted and complex, but can be revealed through case studies. University patents are only one mechanism of transfer from universities to industry. Others include the following: licensing, generating academic spin-offs, collaborative research, contract research, consulting, ad-hoc advice and networking for practitioners, as well as teaching, joint publications with industry, staff exchanges, and joint student supervision.[41] Almost all of these mechanisms of coordination occur outside "the technology transfer office centered coordination" model.

---

[38] Stevens, A. J. (2004). "The Enactment of Bayh-Dole." Journal of Technology Transfer **29**: 93-99.
[39] Ibid.
[40] Grimaldi, R., M. Kenney, D. S. Siegel and M. Wright (2011). "30 years after Bayh-Dole: Reassessing academic entrepreneurship." Research Policy **40**: 1045-1057.
[41] Ibid.

Industry visitors spending time in universities, and university faculty and researchers taking sabbaticals or other time to spend in company labs are common mechanisms of bidirectional exchange.

In an analysis of the origins of Silicon Valley, historian Lécuyer notes the critical importance of the bidirectional ties between university and industry. He shows how Stanford researchers relied heavily on technologies and manufacturing process technologies developed in Silicon Valley to advance their own research. Only by having close relations with cutting edge industry, whose personnel they could invite to Stanford as collaborators, were Stanford researchers able to make technological innovations of their own, while training engineers to become the workforce of the newest technologies.[42] Stanford and UC Berkeley provided much of the basis for Silicon Valley, but *they could not have done so without feedback loops from Silicon Valley helping them stay at the forefront of industry*.

This is a point echoed by Martin Kenney and his collaborators in a book analyzing the role of University of California schools in their respective economies, such as Silicon Valley, San Diego, Los Angeles, Santa Barbara, and Davis (and Napa Valley). The industry environment surrounding the university was critical in shaping how the universities could contribute to local economic development.[43] This emphasizes the point that university-industry ties are not a one-way street with university technologies harvested by industry, but that successful universities depend on effective ties with the surrounding industry.

In fact, while developing Stanford into a world-class research university in the 1950s, Dean Fredrick Terman explicitly made efforts to take problems that were facing industry, which could possibly lead to major breakthroughs if theoretical problems were solved, and encouraging faculty to take those theoretical problems as research agendas within the university. Subsequent breakthroughs in solid-state physics and other areas drove the revolution from vacuum tubes to semiconductors, placing Stanford as a core of Silicon Valley at the center of the computer revolution from the 1960s onward.

UC Berkeley, the other core of Silicon Valley, was the first UC campus to enter semiconductor research, with a former Bell Labs engineer establishing the first integrated circuits laboratory at any US university.[44] Faculty interested in semiconductors took sabbaticals in Silicon Valley firms, transferring innovative designs to industry, facilitating the hiring of students by local startups, and licensing intellectual property. Electronic design automation firms

---

[42] Lécuyer, C. (2006). Making Silicon Valley : innovation and the growth of high tech, 1930-1970. Cambridge, Mass., MIT Press.

[43] Lécuyer, C. (2014). Semiconductor Innovation and Entrepreneurship at Three University of California Campuses. Public universities and regional growth : insights from the University of California. M. Kenney and D. C. Mowery. Stanford, CA, Stanford University Press: 20-63.

[44] Donald Pederson received a PhD from Stanford University in electrical engineering in 1951, working for Bell Laboratories until 1955, when was hired by UC Berkeley's department of Electrical Engineering and Computer sciences.

including Synopsys and Cadence Design Systems grew out of these efforts.[45]

Box 2: Examples of multifaceted University-Industry ties

Stanford student A was an excellent undergraduate student in computer science, who went on to work for a major IT firm after graduation. The IT firm was introducing path breaking new IT services—an online app store. Former student A was part of the team that developed the app store, and through his close ties to a professor from his undergraduate days, he was invited to offer a one term course at Stanford in computer science on how to write apps for the app store—the first such course at a university level. Former student A motivated a large number of students who became his students, and when he left the major IT firm to start his own company, a news aggregation app, many of those students came with him to work at the startup. In this way, a student who went into industry brought experience to the classroom, cultivating the next generation of students who then followed him to his own startup. Expertise and people flowed in both directions.

At the senior level, a highly decorated American economist, Hal Varian, who had an undergraduate degree from MIT a PhD from UC Berkeley, and a longtime appointment at Berkeley, became the chief economist of Google. He had spent a sabbatical at Google while it was still a small company. He was so enamored with the possibility that the wealth of information could provide that he eventually decided to become part time at the university, building a new research agenda as chief economist at Google with the wealth of data they have to offer. His path breaking work on auctions is often cited as a critical influence in building Google's successful auction-embedded advertising model, in which prices for ads are determined by a variant of an auction model. In Varian's own words, he was having so much fun at Google that he retired from the university, becoming full time at Google. This was not a cushy post-retirement position, but an influential position at the forefront of theory, which allowed him to interact with some of the best young minds coming out of school, as well as those from other areas of industry.

8.3. Stanford's Technology Licensing Office

Stanford University, at the heart of Silicon Valley, provides some sobering data about their technology licensing office, commonly considered the most successful among universities. Put simply, Stanford cannot rely on royalties for university operating expenses. The Office of Technology Licensing was established in 1970, and since then, over 10,000 patent and invention disclosures have come to the office, with approximately 4200 licenses. Of those, about 1200 are active. While approximately $1.66 billion has been generated by royalties—which sounds like a very large number—it turns out that over $1.0 billion came from only three big inventions. In short, three out of ten thousand were big winners, generating 2/3 of all income over the course of 44 years. Only 33 cases generated over $5 million, with 87 generating $1 million or more in

[45] Lécuyer, C. (2014). Semiconductor Innovation and Entrepreneurship at Three University of California Campuses. Public universities and regional growth : insights from the University of California. M. Kenney and D. C. Mowery. Stanford, CA, Stanford University Press: 20-63.

royalties. In 2014, there was approximately $108 million in royalty revenue; 644 inventions generated income, but only brought in royalties of over $100,000, with 6 cases bringing in $1 million or more. The *legal expenses* were a staggering $9.8 million, just under 10% of the revenue.[46]

These amounts may seem large, but put in perspective, Stanford University's total operating budget for FY 2012-2013 was $4.4 billion. It received $1.27 billion in sponsored research, with 84% of that coming from government sponsors. The industry affiliate programs, of which the campus has 56, generated $193 million. The university's endowment was $17 billion, and pre-specified returns from investments of the endowment can be used toward operating expenses.[47]

The corporate affiliate programs are scattered throughout the university, which includes 7 schools: Business, Earth Sciences, Education, Engineering, Humanities and Sciences, Law, and Medicine. Many of the corporate affiliate programs include the ability for corporate sponsors to send researchers into university labs. Engaging in joint research with PhD students can give them access to valuable employment recruitment opportunities. For professors, having corporate affiliate sponsors can help employ PhD students in their lab. (It is important to note that for a vast majority of PhD students, their admission into the PhD program includes guaranteed funding that will pay their tuition and a stipend for living expenses—meaning that they are able to make an independent living while attending graduate school.) This can enable a virtuous cycle of professors engaged in important areas of research getting a large number of corporate affiliate sponsors who can fund a large number of PhD students, which in turn enables the professor to do more research in the area, thereby attracting more corporate sponsors.

Yet, income from licenses and patenting is clearly not the primary reason Stanford and UC Berkeley engage in these activities and encourage technology transfers to industry. The value lies in the long-term relationships with industry that ensure that faculty and research are defining cutting edge new technological trajectories. This gives faculty competitiveness for the next round of federally funded research, which is actually the main portion of the university's research income, as covered in the next section.[48] Strong university-industry ties can also anchor relationships that can lead to philanthropic gifts. In 2001, for example, Stanford received a $400 million gift from Hewlett-Packard; its total gift income from FY 2012 was over $1 billion.

Strong industry university ties can also lead to new private-public partnerships, such as the $500 million, ten-year contract between BP and primarily UC Berkeley, which led to the creation of a new Energy Biosciences Institute.

---

[46] Stanford Technology Licensing Office Presentation, November 2014.
[47] http://facts.stanford.edu
[48] Lenoir, T. (2014). Inventing the entrepreneurial university: Stanford and the co-evolution of Silicon Valley. Building Technology Transfer Within Research Universities: An Entrepreneurial Approach. T. J. Allen and R. P. O'Shea. Cambridge, UK, Cambridge University Press**:** 88-128.

8.4. Government – University Ties

The government played a critical role in the establishment and growth of the research universities of Stanford and University of California at the heart of Silicon Valley. Even beyond their historical legacy, government continues to provide a very large portion of research funding for these universities. What is critical to note, however, is that the research budgets are allocated through multiple different agencies, with evaluations of grant approval based on blind peer-reviewed boards comprised of scientists and other members who do not necessarily work at the agencies providing funding. In other words, independent advisory boards evaluate the merits of proposals, which are competitive, and those winners are awarded on a project basis rather than central bureaucracy allocations of budgets to particular institutions. Even the University of California system has a majority of its operating budgets for research come from competitive rather than guaranteed state funding sources. For many disciplines, therefore, faculty members' ability, or potential ability, to apply for and successfully receive large government grants can play a role in hiring and tenure decisions.

UC Berkeley was California's first public university, founded in 1868. It has enjoyed considerable strength in basic research. Its faculty, alumni, and researchers have a combined 72 Nobel prizes total, and Berkeley scientists are responsible for 6 elements in the periodic table (including the humorously named berkelium, and lawrencium, discovered in the Lawrence Berkeley labs.) During World War II it was responsible for managing the national laboratories, including Los Alamos, which produced the atomic bomb, with Robert Oppenheimer and Edward Teller as faculty members.

Stanford's ascent as a top US university occurred largely during the Cold War, through a re-orientation that entailed aggressively pursuing government research budgets and forging strong ties with industry. Until the university experienced a financial crisis in the early postwar era, it largely kept its distance from government research, leaving that to public universities such as UC Berkeley. There was a sense that private universities should not be participating in the war effort. Fredrick Terman, a mechanical engineering professor who later became dean of the engineering school and provost, is largely credited with transforming Stanford.

Terman reoriented the faculty hiring and composition to recruit top talent and encouraged their research in a way that would attract federal funding, while remaining industry relevant. His conception was to build "steeples of excellence." Since the government grants were competitive, the science had to be evaluated by blind peer-reviewed processes by other scientists, so hiring the very best people was critical to getting the major government grants. He also focused on building large PhD programs rather than a focus on practical engineering training. At the same time, Terman focused on hiring faculty that were interested in theoretical problems that would be of interest to industry. *The key concept was obtaining federal funding for scientific research that was simultaneously relevant for industry*. This was *not simply outsourced corporate contract research,* where companies narrowly specified what they wanted from the university, in effect making it a lower cost corporate R&D lab. The questions had to be basic, and considerable effort went into establishing a working relationship in which firms trusted the faculty and university to use their sponsored research funds at their discretion, without micromanagement. The insistence on centrality of the research mission of faculty led Terman to reject contracts for applied research that did not fit the mission of increasing research prowess.[49]

The key conception of Terman, who is often credited primarily with successfully building industry ties, was that his vision was to anchor Stanford in government grants. Others on the board of Trustees and president of the university were actually more interested in building ties with industry, but for Terman, whose vision became the Stanford model, *industry funding was not the primary way to build up the university*. It was instead the way to build a competitive university that could thrive on government funding, especially during the Cold War context.[50]

To expand research staffing, Terman pioneered a system of "salary splitting" rather than increase salaries of faculty already hired. This entailed paying half the salary of a new faulty member from grants and contracts, with research associates and others involved in sponsored project to be covered entirely from contract funds.[51]

Stanford has continued along the trajectory set by Terman, and for FY 2014, 87% of 1.27 billion out of 4.4 operating budget was from government sponsored research. The majority of government funding has gone to the medical center, with Department of Health, and

Figure 19. Stanford's Sources of US Government Research, FY 2014

Government Agency	% of US Government Research
Department of Health and Human Services (DHHS)	65.3
Department of Defense (DOD)	14.2
National Science Foundation (NSF)	11.1
Department of Energy (DOE)	3.8
National Aeronautics and Space Administration (NASA)	3.5
Other	2.1

Source: Stanford University

for UC Berkeley's sponsored research funding, which totaled 738.5 million in 2013, the federal government accounted for 66%, at 486.3 million, and industry at 3%, with 22.9 million (not including the BP contract). The state of California contributed only 10%, with $73.7 million, showing the national stature of Berkeley. The composition of the government funding sources is shown below.

---

[49] Ibid.
[50] Ibid.
[51] Ibid.

Figure 20. UC Berkeley's Sources of US Government Research, FY 2013

Government Agency	% of US Government Research
Department of Health and Human Services (DHHS)	25.3
Department of Defense (DOD)	4.3
National Science Foundation (NSF)	20.3
Department of Energy (DOE)	10.8
National Aeronautics and Space Administration (NASA)	32.5
Other	7

Source: UC Berkeley

Much of the difference in proportions between UC Berkeley and Stanford is accounted for by the medical school at Stanford; between 2012, Stanford's life sciences, which includes the medical school, comprised of just under $538 million out of the university's $903 million total research expenditure. Engineering was 132 million, with non-science and technology amounting to $48 million.[52] Within the University of California system, expenditures at the UC San Francisco Medical Center account for a majority of the entire research expenditures system wide.

Box 3: A note on Stanford endowment and funding

In 2012-2012, Stanford University's total assets were $25.7 billion, of which Stanford's endowment makes up $18.7 billion, the second largest of any private US University, surpassed only by Harvard. Approximately 75% of the endowment is designated for a specific purpose by the contributing donor. Every year, the Stanford Management Company oversees Stanford's financial and real estate assets which produce investment returns that are either used to support annual operating expenses, or reinvested in the endowment. This company employs financial professionals and is completely separate from any academic department or professors. The endowment payout is as follows: instruction and research 30%, student aid 23%, unrestricted 22%, faculty related 20%, library 2%, other 4%.

The largest source of University funding is the income earned from Stanford's endowment, making up 21% of overall funds. Closely following is sponsored research, which constitutes 19% (Harvard 21.6%). Student income pays 16%, health care and services 15%, SLAC 9%, expendable gifts 6%, other income 10%, and other investments 4%. The expenditure of these funds is concentrated mainly on salaries/benefits and operating expenses which represent 59% and 31% respectively.

8.5. Academic Entrepreneurship

Academic entrepreneurship is a focal point for much of the discussion around the Silicon Valley ecosystem that other areas try to emulate. Counting the number of academic startups is therefore a tempting measure of university performance in this area. However, as seen above, the

[52] Stanford financial report

patterns in which universities have an impact on industry can be multifaceted. In a similar fashion, what to count as “academic entrepreneurship” is difficult.

The first point to remember is that in the US overall, the average and median age of entrepreneurs is approximately 40. This means that many are professionals who have gained deep knowledge in large firms, and often have PhD degrees from universities. The image of college students starting successful businesses right out of school—perhaps not even finishing their degree—certainly exists, such as Mark Zuckerberg of Facebook (or Bill Gates of Microsoft), but they are less prevalent than one might expect. Google’s founders, for example, were PhD students at Stanford. The original Silicon Valley success startups, Fairchild Electronics, followed by firms such as Hewlett Packard, then Sun Microsystems, Cisco, and others, were all founded by Stanford graduates that had PhDs or had been professional researchers for some time.

Counts of academic startups usually do not include simply all graduates of a school. Data for all graduates of the school is still being compiled by researchers and are not readily available. However, given that it is very possible that graduates of Stanford or UC Berkeley have utilized interpersonal networks and skills that later enabled them to become entrepreneurs that suggest that the important effects of universities are understated by counting companies started directly out of universities. For example, Stanford alumni that are founders or CEOs of major firms include the founders of Nike, Silicon Graphics, Sun Microsystems, Cisco Systems, The Gap, Trader Joe’s Dolby Labs, McCaw Cellular, Netflix, Wipro Technologies, Mozilla Firefox, IDEO, Paypal, WebEx, Youtube, Whatsapp, Instgram, Snapchat, Flipboard, and presidents of blue chip firms such as Time Warner, Pfizer, eBay, and others. Many of these notable individuals then return to Stanford to give talks or make monetary gifts. They provide stimulus for students to go start their own companies—at some point, even if not directly out of graduation—and they also can provide employment opportunities through recruiting activities at Stanford. Students who graduate and then work for such firms can then become entrepreneurs or follow new entrepreneurs once they gain experience.

UC Berkeley was ranked as third in Forbes’ most entrepreneurial research universities in the US for 2014. The ranking was based on their entrepreneurial ratio, measured as the number of alumni and students who identified themselves as founders and business owners on LinkedIn against the school’s total graduate and undergraduate student body. (The top was Stanford, and MIT was second.)[53] Pitchbook, an M&A, private equity, and venture capital database, created a list of schools whose alumni founded VC-funded companies, between 2010 and the third quarter of 2013. Stanford led with 190, with UC Berkeley as second, with 160.[54]

Located at the core of Silicon Valley, neither Stanford nor Berkeley has numerical targets or explicit incentives for faculty to become involved in entrepreneurship. Entrepreneurship is

[53] http://www.forbes.com/sites/liyanchen/2014/07/30/startup-schools-americas-most-entrepreneurial-universities/
[54] http://www.geekwire.com/2013/top-universities-producing-vcbacked-entrepreneurs/

instead viewed as a way to retain high quality faculty, and it is supported. Being involved in entrepreneurship can also be a way to maintain a strong connection with working on cutting edge areas and help with faculty's teaching and research. The Stanford Faculty Entrepreneurship seminar explicitly raises the point that technology transfer through the Office of Technology licensing may be best for some areas, but for others, non-exclusive licenses or openly publishing results might be the best route.[55]

[55] Lenoir, T. (2014). Inventing the entrepreneurial university: Stanford and the co-evolution of Silicon Valley. Building Technology Transfer Within Research Universities: An Entrepreneurial Approach. T. J. Allen and R. P. O'Shea. Cambridge, UK, Cambridge University Press: 88-128.

9. Key Experiences and Observations by Japanese Firms: Challenges and Opportunities

The following section is a distillation of observations by Japanese firms, large and small, that have all attempted to make use of the Silicon Valley ecosystem. Many of these issues are not specific to a single company, but are common to many. Most of the issues stem from challenges in managing Silicon Valley operations, which is in a context that operates vastly differently from the global headquarters in Japan.

9.1. Support from Headquarters and Local Autonomy

A key issue facing almost all large companies operating in Silicon Valley is the degree of local autonomy given to the Silicon Valley office. What is the mandate? How closely is it integrated into the company's headquarters? How much financial autonomy does it have? These are some of the questions that must be asked seriously.

The first point of difficulty that many large Japanese firms have faced initially was in the "*information gathering*" activities. Initial outposts often used to have a small number of employees (1-3) based in Silicon Valley to gather information about the latest emerging technology trends. Here, they usually discovered two challenges.

First, there was no strong incentive for promising new startups to talk to them. Large firms tended to not make it obvious what the merit was to the startups in question. The most promising startups were naturally more interested in collaborating or being bought by Silicon Valley firms or other firms with a strong track record of working well with companies or buying them. The Japanese large firms did not fit into this category, so the most promising startups were the ones least interested in talking to them.

Second, if the information the Silicon Valley employee sent to headquarters were too cutting-edge—so far so that the strategy and management departments did not get a good sense of what the potential was—the Silicon Valley reports were not acted upon. Some Silicon Valley employees even reported that in conversations among themselves, some would find that sending slightly older information that was already common knowledge was received better by the Japanese headquarters because it seemed more familiar to them; despite having information about earlier developments of trends that would later become important, headquarters wouldn't respond to information that they were not already somewhat familiar with—therefore rendering the entire exercise of Silicon Valley information gathering not very valuable.

One theme that this alludes to is a challenge that faces multinational corporations in many circumstances: they need to sell the importance of Silicon Valley to the company's headquarters, while also appealing the importance of the company to Silicon Valley. Employees in Silicon Valley therefore find themselves having to "market" themselves and their activities in both directions—headquarters and Silicon Valley. Since the function of the Silicon Valley office is usually not simply a sales operation, it holds a special position within the company, and its performance cannot be measured as directly as other offices whose function is to generate sales to the local markets.

This is actually the same for government initiatives. Silicon Valley is the recipient of attention from governments around the world, many of which like to roll out programs and hold events. Countries as divergent as Finland, Denmark, Sweden, Israel, Poland, Mexico, and all manner of Asian countries have various policies to encourage entrepreneurs from their respective countries to come to Silicon Valley for short trips and training sessions, and they tend to have a variety of incentives to bring companies to their own countries while building bridges for their companies to come to Silicon Valley. Silicon Valley is therefore full of events held by various governments around the world that are all aiming at the same thing—getting access to insiders in Silicon Valley ecosystem. The problem, of course, just like firms, is that each country's government must clearly present the merit to Silicon Valley actors to attend such events beyond the fact that they are holding it. Every program tends to want participants from their own country to cultivate meaningful ties with Silicon Valley ecosystem players, but they must appeal to those Silicon Valley actors. At the same time, Silicon Valley branch offices must appeal to their home government the importance of their activities in Silicon Valley. Very often, such offices promise the home government that various access can be facilitated, therefore attracting attention at home, but there is insufficient capacity to do the work to attract the interest of relevant actors in Silicon Valley. Programs held in Silicon Valley therefore suffer the danger of being "home-country facing" rather than appealing to Silicon Valley.

Internal company ties when sending people to Silicon Valley are important. Historically, many Japanese companies have sent R&D people to Silicon Valley to find new technology seeds—but the R&D people did not have sufficiently strong ties to the strategic development divisions. Therefore, even if the R&D employees find interesting technologies, and even move to license the technologies or even propose to buy a company, if the strategic development efforts of the company are not engaged, these efforts are not reflected in the company's actions or strategies.

9.2. Employment

One of the strengths of Silicon Valley is the abundance of high quality talent, but it is often a significant challenge for Japanese companies to access and make use of that talent. A mismatch between the Japanese large corporate model of strong personnel departments who control human resources in a centralized manner over long time periods is the almost the opposite of Silicon Valley personnel practices, particularly in small firms.

Pay scale differences between Silicon Valley talent and Japanese headquarters' pay-scale is an obvious problem. For example, a large Japanese IT firm had an algorithm that had potentially valuable commercial applications, and decided to set up a Silicon Valley office to try to commercialize it. The problem was that in order to hire someone at Silicon Valley wages, initially the personnel department in Tokyo was unable offer anything other than the standard firm pay-scale for new employees.

For firms who are able to offer competitive wages, the next problem is selecting employees, since large Japanese firms do not have experience evaluating top talent. As several firms trying to recruit talent in Silicon Valley noted—if the Japanese firm is not well known, then many of the candidates will not be top quality talent. There is a market for firms and individual consultants that provide recruiting services, but in the end, the actual business team often needs to spend a great deal of time evaluating talent.

Then, once a team is put together, a potential challenge is managing cross-border teams in which pay disparities are extreme. For Japanese who are sent to Silicon Valley, the stability of employment and subsidies for housing and living expenses can make differences in compensation not a morale problem. However, as globalization deepens with more teams with very different pay levels, this is poised to be a challenge moving forward. An interesting anecdote from a Google engineer is that in the normal course of work, it is often impossible to distinguish who is a newcomer, and who has been at Google a long time—as well as pay scales. It is not unusual for certain team members to be paid far more than the project leader, but the company culture makes this issue relatively unimportant.

10. Conclusion: Looking Forward

This report fills numerous gaps in existing discussions about how Silicon Valley can benefit Japan, both through policy lessons for government as well as for lessons for firms interested in making use of Silicon Valley. Effective strategies must be anchored in a solid understanding of Silicon Valley—not only how the economic ecosystem works today, but also why it developed the way it did, in order to understand the trajectory and dynamics of development. For example, key points about the lack of local government coordination and strategy are critical to understand, as it the lack of public infrastructure providing opportunities for entrepreneurship such as Uber. The limits to Silicon Valley's physical growth as a region are also hinted at, although we can expect it to continue to produce disruptive innovations.

Next steps in research should include the following components. From a policy standpoint, it should examine the institutions and organizations put in place by non-US governments. It should also examine how Japanese firms have been challenged in taking advantage of Silicon Valley, as well as examples of Japanese startups firms and business divisions in larger Japanese firms that did succeed, along with comparisons to other non-US larger companies and startups for non-American founders. With a recent wave of fast-growth Japanese startups and recently successful Japanese firms entering Silicon Valley, combined with renewed vigor by several notable large Japanese companies an accurate portrayal of the Silicon Valley economic ecosystem should provide a good building block for the future successful strategies by firms and the Japanese government.

References

- (2005) "History of BART to the South Bay." San Jose Mercury News.

- Baldwin, C. Y. and K. B. Clark (2000). Design rules. Cambridge, Mass., MIT Press.

- Chesbrough, H. W. (2003). Open innovation : the new imperative for creating and profiting from technology. Boston, Mass., Harvard Business School Press.

- Cohen, S., J. B. DeLong and J. Zysman (2000). Tools for Thought: What is New and Important about the "E-conomy". Berkeley, CA, Berkeley Roundtable on the International Economy, University of California at Berkeley.

- Dasher, R. (2013). "Disruptive Ideas, Open Innovation, and New Value Chains: Trends in Asia."   Retrieved June 15, 2014, from http://asia.stanford.edu/us-atmc/wordpress/wp-content/uploads/2013/10/131003-Dasher-EE402A.pdf.

- Deitch, K. and S. Deitch (2002). The boulevard of broken dreams. New York, Pantheon Books.

- Fallick, B., C. A. Fleischman and J. B. Rebitzer (2006). "Job-hopping in Silicon Valley: Some evidence concerning the microfoundations of a high-technology cluster." The Review of Economics and Statistics **88**(3): 472-481.

- Fernandez, L. and N. Miranda. (2014). "Nation's Largest Homeless Encampment, "The Jungle," Dismantled."   Retrieved January 20, 2015, from http://www.nbcbayarea.com/news/local/Game-of-Whack-a-Mole-Homeless-Upset-to-be-Evicted-by-Police-From-The-Jungle-in-San-Jose-284745461.html.

- Grimaldi, R., M. Kenney, D. S. Siegel and M. Wright (2011). "30 years after Bayh-Dole: Reassessing academic entrepreneurship." Research Policy **40**: 1045-1057.

- Hogan, M. (2014) "Living in a Fool's Paradise." Boom: A Journal of California **4**.

- Kenney, M. (2000). Understanding Silicon Valley : the anatomy of an entrepreneurial region. Stanford, Calif., Stanford University Press.

- Kenney, M. and R. Florida (2000). Venture Capital in Silicon Valley: Fueling New Firm Formation. Understanding Silicon Valley : the anatomy of an entrepreneurial region. M. Kenney. Stanford, CA, Stanford University Press**:** 98-123.

- Kushida, K. E., J. Murray and J. Zysman (2013). "Clouducopia: Into the Era of Abundance." CLSA Blue Book **January**.

- Kushida, K. E., J. Murray and J. Zysman (2015). "Cloud Computing: From Scarcity to Abundance." Journal of Industry, Competition and Trade.

- Lazonick, W. (2009). "The New Economy Business Model and the Crisis of U.S. Capitalism." Capitalism and Society **4**(2).

- Lécuyer, C. (2014). Semiconductor Innovation and Entrepreneurship at Three University of California Campuses. Public universities and regional growth : insights from the University of California. M. Kenney and D. C. Mowery. Stanford, CA, Stanford University Press**:** 20-63.

- Lécuyer, C. (2006). Making Silicon Valley : innovation and the growth of high tech, 1930-1970. Cambridge, Mass., MIT Press.

- Lee, C.-M., W. F. Miller, M. G. Hancock and H. S. Rowen, Eds. (2000). The Silicon Valley edge : a habitat for innovation and entrepreneurship. Stanford, Stanford University Press.

- Lenoir, T. (2014). Inventing the entrepreneurial university: Stanford and the co-evolution of Silicon Valley. Building Technology Transfer Within Research Universities: An Entrepreneurial Approach. T. J. Allen and R. P. O'Shea. Cambridge, UK, Cambridge University Press**:** 88-128.

- Leslie, S. (2000). The Biggest "Angel" of Them All: The Military and the Making of Silicon Valley. Understanding Silicon Valley : the anatomy of an entrepreneurial region. M. Kenney. Stanford, CA, Stanford University Press.

- McCord, P. (2014) "How Netflix Reinvented HR." Harvard Business Review.

- Rao, A. (2013). A History of Silicon Valley: The Greatest Creation of Wealth in the History of the Planet, 2nd Edition.

- Saxenian, A. (1994). Regional advantage : culture and competition in Silicon Valley and Route 128. Cambridge, Mass., Harvard University Press.

- Saxenian, A. (2006). The new argonauts : regional advantage in a global economy. Cambridge, Mass., Harvard University Press.

- Stevens, A. J. (2004). "The Enactment of Bayh-Dole." Journal of Technology Transfer **29**: 93-99.

- Sturgeon, T. J. (2000). How Silicon Valley came to be. Understanding Silicon Valley: Anatomy of an Entrepreneurial Region. M. Kenney, Stanford University Press**:** 15-47.

- Sturgeon, T. J. (2002). "Modular production networks: a new American model of industrial organization." Industrial and corporate change **11**(3): 451-496.

- Tan, G. (2014). Making Things People Want. Stanford University, Stanford US-Asia Technology Management Center.